STATE BANK OF INDIA

CORPORATE CENTRE, NARIMAN POINT, MUMBAI 400021.

PART – A: TECHNICAL BID

INVITATION OF E-TENDERS

FOR

PROPOSED INTERIOR WORKS OF SBI OUTFITS AT 7th TO 10th FLOORS OF C-WARD BUILDING LOCATED AT VASHI, NAVI MUMBAI

TENDER SUBMITTED BY:

NAME : _____

ADDRESS : _____

_____

DATE : _____

EMAIL: : _____

ARCHITECT:

M/s. Architect Narayan and Associates Pvt. Ltd.
304, 3rd Floor Antarikh Building,
Makhwana Road, Marol,
Andheri (E), Mumbai – 400 059
E-mail: rln@architectnarayan.com

CLIENT:

THE DEPUTY GENERAL MANAGER (PREMISES)
State Bank of India,
9TH Floor, Corporate Centre, Nariman Point, Mumbai-400021.
Tel: 022 2274 0906
E-mail: dgmpremises.cc@sbi.co.in

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NOTICE INVITING TENDERS

TENDER ID: CC20260401

TENDER FOR: PROPOSED INTERIOR WORKS AT 7th TO 10th FLOORS OF C-WARD BUILDING LOCATED AT VASHI, NAVI MUMBAI

SBI, Global markets, Corporate Centre, Mumbai invites E-tenders for captioned work from firms / contractors of repute satisfying the set eligibility criteria in two bid system for the following work who are only entitled to quote for this tender.

Details of the tenders are as under:

Sr.No.	Particulars	Details
1	Name of work	Tender for Proposed Interior Works at 7th to 10th floors of C-Ward building located at Vashi, Navi Mumbai
2	Nature of Work	Interior furnishing, Supply and installation of furniture, fixtures, furnishing items, electrical, data cabling, HVAC and firefighting systems, etc.
3	Estimated Cost put to Bid	**Rs. 13,77,96,394.00** (Rupees: **Thirteen crores Seventy Seven lakhs Ninety Six thousand Three Hundred Ninety Four only.)** Interior & Furniture Works: Rs. 8,38,81,193.00 Electrical Works: - Rs. 2,30,68,242.00 HVAC Works: - Rs. 1,99,14,842.00 Fire & Security System Works: - Rs. 1,09,32,117.00
4	Time allowed for completion	**03 months (Including monsoon and public holidays)**
5	Earnest Money Deposit	**Rs.13,78,000/- (Rupees Thirteen Lakh Seventy Eight Thousand Only)** by means of Demand Draft / Pay Order (Valid for a period of 90 Days from the last date of submission of the tender) from any scheduled Nationalized Bank drawn in favor of Deputy General Manager (Premises), State Bank of India and payable at Mumbai.
6	Initial Security Deposit (ISD)	2% of contract amount (EMD will be returned on receipt of ISD). The successful bidder(s) shall be responsible to deposit Initial security deposit @ 2% of the Contract Value by way of demand draft in favor of Deputy General Manager (Premises), State Bank of India and payable at Mumbai within 10 days from the date of receipt of "Work Order" from SBI/Architects. The SBI may consider accepting ISD in the form of Bank Guarantee issued by any Scheduled Bank in the format supplied/approved by the SBI within its sole discretion but the same cannot be considered as a right of the bidder.

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7	Additional security Deposit	In case L-1 bidder quotes abnormally low rates (i.e.10% or more, below estimated cost put to tender), the bank may ask such bidder to deposit Additional Security deposit (ASD)/Additional performance Guarantee (APG) shall be applicable if the bid price is below 10 % of the estimated cost put to tender. The amount of such ASD/ APG shall be the difference between 90 % of estimated cost put to tender and the quoted price, for due fulfillment of contract. Such ASD could be in the form of FDR / Bank's guarantee in the Bank's name as per format approved by the Bank. On successful completion of work ASD will be returned to the contractor. In case contractor fails to complete the work in time or as per tender specification or leave the job incomplete, the bank will be at liberty to recover the dues from ASD or to forfeit such ASD as the case may be within its sole discretion.
8	Date of availability of tender documents on Service Provider's website	
	(a) **Online Technical Bid**	**10.04.2026 to 30.04.2026** Available at M/s e-Procurement Technologies Ltd., our Service Provider's portal https://etender.sbi/SBI
	(b) **Online Price Bid**	**10.04.2026 to 30.04.2026** Available at M/s e-Procurement Technologies Ltd., our Service Provider's portal https://etender.sbi/SBI
	(c) Last date and time for receipt of written queries for clarification from bidders for Pre-bid meeting.	**20.04.2026 at 05.00 PM** **(Bid Queries to be sent to operations.gmu@sbi.co.inonly)** Note: The intended bidders, along with queries have to mail the details of authorized representative viz name, mobile no., email id along with authorization letter from the bidder.
	(d) Date of **Pre-bid meeting and address** of Pre-bid meeting	**At 11:00 AM on 21.04.2026** Office of The Deputy General Manager (Premises), State Bank of India, 9th Floor, Corporate Centre, Nariman point, Mumbai. (Only written queries submitted by the bidders till stipulated date and time will be discussed and clarified in the meeting).
9	Last date & time for submission of submission of online bid, original EMD, copy of receipt of deposition of original EMD and other documents as specified in the bid document	**30.04.2026 by 03:00 PM** Note: It is sole responsibility of the bidder to ensure submission of their EMD with tender document by stipulated date and time at specified address failing which they will be disqualified.
10	Address for submission of EMD	The Deputy General Manager (Premises), State Bank of India, 9th Floor, Corporate Centre, Nariman point, Mumbai.

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11	Last date & time for submission of Online Technical & Price bid	**30.04.2026 by 03:00 PM** at Service Provider's portal https://etender.sbi/SBI
12	Date and Time of opening of Online Technical Bid	**30.04.2026 by 04:00 PM**
13	Date and Time of opening of Online Price Bid	To be intimated to qualified contractors (scoring at least 70% marks) on their provided email-IDs after scrutiny / approval of technical bids
14	Defects Liability period	One year from the date of virtual completion of work / Final handing over of the site, whichever is later.
15	Liquidated Damages	0.50% per week subject to max. 5% of contract amount for delay in completion of work.
16	Validity of offer	90 days from the date of opening of Price-bid
17	Value of Interim Certificate	**Rs. 3.00 cores (Rs. Three crores only)** No advance on materials / plant / machinery or mobilization advance shall be paid under any circumstances
18	**Submission of Technical Bid**	1. Contractors shall download the entire Technical Bid to get acquainted with the terms and conditions and **shall upload compulsorily the required documents of the Technical Bid** without fail in the e-tendering portal after putting the signature and seal. Failing to upload as stated above, the tender will be rejected. 2. However, **L1 Tenderer** should submit the whole technical bid spirally bound securely and in serial order containing all pages duly signed with company seal and date to this Office within 15 days of receipt of confirmation. Failure to submit the hardcopy of Technical Bid may render the bidder disqualifies.
19	**Note:-**	1.The make of materials should be chosen strictly from the preferred makes as given in the tender. 2.Any clarifications sought after opening of the tenders will not be entertained at any cost. 3. Bidder should visit the website till last date of submission for changes/ corrigendum, if any. 4. Bank reserves the right to cancel or postpone the tenders at any stage without assigning any reason. 5.Claims for revision of the Quoted price by any bidder after the tender will not be entertained.

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20	**e-Tender Service Provider Contact persons:** Primary Contact Numbers: - M:- 9081000427, 9904407997 . 1. Jaymeet Rathod: 079-68136829, jaymeet.rathod@eptl.in 2. Vinayak Khambe: 079-68136835, vinayak.k@eptl.in 3. Nadeem Mansuri: 079-68136853, nadeem@eptl.in, 4. Nandan Valera: 079-68136843, nandan.v@eptl.in 5. Hemangi Patel: 079-68136852, hemangi@eptl.in 4. Kanchan Kumari: 079-68136820, kanchan.k@eptl.in 5. Deepak Narekar: 079-68136863, deepak@eptl.in 6. Anshul Juneja: 079-68136840, anshul.juneja@eptl.in 7. Salina Motani: 079-68136831, salina.motani@eptl.in 10. Devang Patel: 079-68136859, devang@eptl.in

21. The intending bidder must read the tender terms and conditions carefully. He should only submit his bid if he considers himself eligible and he is in possession of all the documents required. No conditions other than mentioned in the tender will be considered, and if given they will have to be withdrawn before opening of the price-bid.

22. This information and instructions for bidders posted on website shall form part of bid document.

23. The bid document consisting of plans, specifications, schedule of quantities of various types of items to be executed and the set of terms & conditions of the contract to be complied with and other necessary documents can be seen and downloaded from website **http://etender.sbi/SBI/ or www.bank.sbi** free of cost.

24. The intending bidder must have valid class-III digital signature certificate with encryption key (combo type) to perform any operations/transactions on the e-tendering portal / website and the bidder should download and install the eMsigner on their system as per instruction available on download section of https://etender.sbi/SBI/

25. On opening date, the bidder can login and see the bid opening process. After opening of bids he will receive the competitor bid sheets.

26. Bidder can upload documents in the form of **JPG** format and **PDF** format. Bidder should ensure that the document uploaded is legible and full documents page is properly scanned Certificate of Financial Turn Over: At the time of submission of bid contractor may upload Affidavit/Certificate from CA mentioning Financial Turnover of last 5 years or for the period as specified in the bid document and further details if required may be asked from the contractor after opening of technical bids. There is no need to upload entire voluminous balance sheet.

27. The Technical Bid shall be opened first on due date and time as mentioned above. The time and date of opening of financial bid of contractors qualifying the technical bid shall be communicated to them at a later date.

28. SBI reserves the right to reject any prospective application without assigning any reason thereof and to restrict the list of qualified bidders to any number deemed suitable by it, if too many bids are received satisfying the minimum laid down criteria.

29. SBI reserve their rights to accept or reject any or all the tenders, either in whole or in part without assigning any reason for doing so and any claim / correspondence shall be entertained in this regard.
30. Tenders received without EMD (in original) shall be summarily rejected and such tenders shall not be allowed to participate in the online price bidding process.

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31. In case the date of opening of tenders is declared as a holiday, the tenders will be opened on the next working day at the same time.

32. The bid become not eligible if bidder does not upload scanned copies of all the documents stipulated in the bid document (including GST Registration and as stipulated in the bid documents).

33. For any clarifications regarding E-Tendering procedure, System requirements etc. please contact M/s E-Procurement Technologies Limited, Ahmedabad, whose address is mentioned in the NIT.

Yours Faithfully,

For M/s. Architect Narayan and Associates Pvt. Ltd.,
Mumbai
Architect & Interior Designer

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MINIMUM ELIGIBILITY CRITERIA FOR PRE-QUALFICATION

The Firms / Contractors applying must fulfil each of the following criteria as interior decoration firm. The applications of the firms/contractors not fulfilling the following criteria will not be considered for prequalification.

The Companies / Firms that fulfill the criteria as given below shall be eligible:

a) i. The Company should be either a Partnership or a Public Limited Company or a Private Limited Company or Proprietorship firm registered under the Indian Companies Act 1956.

   ii. The Company / Firm should have valid registration with Central/ State Govt. bodies / Public sector Undertakings, PSB's / Nationalized Banks / MES / Railway etc.

b) The firm / company should have an experience of minimum **07** years in relevant field i.e. Interior Renovation of Commercial buildings as on **31.03.2026**.

c) The firm / company should have registration with GST, PF, ESIC, PAN No. and Prof. Tax etc. (as applicable) submit the proof of the same.

d) The firm must have valid electrical contractor license issued by the competent authority of State/ Central Government Department. In case the bidder does not possess such license, the bidder shall submit an undertaking that they will engage a duly licensed electrical contractor with **requisite eligibility** and shall submit valid license along with other required credential within **7 days from award of the work**.

e) The firm should produce acknowledgement, and copy returns of IT for the last three years along with CA certificate.

f) **Bidders / Contractors** who fulfil the following requirements shall be eligible to apply. Joint ventures are not accepted.

g) The bidder should have satisfactorily completed the works mentioned below during the last **7 (seven) years** ending on **31.03.2026:**

   At least one similar project of minimum **Rs.11.02 Crores** each or two similar projects **of minimum Rs.6.89 Crores** each or three similar projects of minimum **Rs. 5.51 Crores** each during **last 7 years ending on 31.03.2026**. These projects should be Interior renovation of **Commercial Building projects** and the value of work mentioned is excluding GST.

   "Similar Works":- The definition of similar work shall mean completed Interior Renovation Works which should include Civil, Interior, Modular Furniture, Plumbing & Sanitary, Waterproofing, HVAC, Electrical, IT, CCTV works etc (all the components executed under single contract) executed for Commercial buildings for Central Govt. Dept./State Govt. Dept./ Semi Govt. Dept. / PSU / Public sector Banks / Reputed Private Sector Organisations listed on Stock Exchange/ NSE/ BSE during last 7 years as on 31.03.2026. Please refer brief description of work contained in this document. The work order and the completion certificate shall clearly indicate works completed pertaining to the above-mentioned services and as such the break-up thereof, which has to satisfy the minimum works qualifying criteria.

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h) **Specialized Electrical, HVAV & firefighting work works:**

The bidders shall possess a valid Electrical license. In case the bidder does not possess such license, they shall engage agencies having the requisite eligibility as mentioned below and valid licenses for execution of specialized electrical, HVAC and firefighting work.
Such specialized works shall be executed only through approved and eligible agencies. The successful bidder shall submit the details of their associated specialized agencies along with their credential within **7 days from the date of award of work** for approval by the Bank.
The decision of Bank /Engineer-in-charge in this regard shall be final and binding.

The Contractor has to submit proof of eligibility criteria for Electrical, HVAC and Fire-fighting sub-contractors (if engaged separately), and other specialized agencies for lifts, STP etc. and as advised by the Project Architect as per conditions specified below:

i) Electrical works:
Eligibility criteria for Electrical contractors (if subcontracted/ associated by the Applicant contractor): The firm should have executed & successfully completed following similar works during last 7 years ending 31.03.2026.

a) Three similar works each costing not less than Rs 0.92 Cr excluding GST (40% of the estimated cost.)

Or

b) Two similar works each costing not less than Rs 1.15 Cr excluding GST (50% of the estimated cost.)

Or

c) One similar work costing not less than Rs 1.85 Cr excluding GST (80% of the estimated cost.)

Similar electrical work shall mean "Supply, Installation, testing & commissioning of Electrical works in high rise buildings".
The Electrical subcontractor/ firm shall have valid license issued by Chief Electrical Inspector (or his Office) for taking up electrical works in Maharashtra.

ii) HVAC works:-
Eligibility criteria for Fire-fighting contractor (if subcontracted/ associated by the Applicant contractor): The firm should have executed & successfully completed following similar works during last 7 years ending 31.03.2026.

a) Three similar works each costing not less than Rs 0.80 Cr excluding GST (40% of the estimated cost.)

Or

b) Two similar works each costing not less than Rs 1.00 Cr excluding GST (50% of the estimated cost.)

Or

c) One similar work costing not less than Rs 1.60 Cr excluding GST (80% of the estimated cost.)
Similar HVAC work shall mean "Supply, Installation, testing & commissioning of HVAC works".

The subcontractor/ firm shall have valid wireman/ electrical license from the Directorate of Maharashtra for taking up works in Maharashtra.

iii) Fire fighting works:-

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Eligibility criteria for Fire-fighting contractor (if subcontracted/ associated by the Applicant contractor): The firm should have executed & successfully completed following similar works during last 7 years ending 31.03.2026.

a) Three similar works each costing not less than Rs 0.45 Cr excluding GST (40% of the estimated cost.)

Or

b) Two similar works each costing not less than Rs 0.55 Cr excluding GST (50% of the estimated cost.)

Or

c) One similar work costing not less than Rs 0.87 Cr excluding GST (80% of the estimated cost.)

Similar electrical work shall mean "Supply, Installation, testing & commissioning of Fire-fighting works".

The subcontractor/ firm shall have valid license from the Directorate of Maharashtra Fire Services for taking up works in Maharashtra.

i) **Average Annual Financial Turnover:**
Bidder should have had Average Annual Financial Turnover of **Rs. 4.13 Crores** on interior renovation works during the last three years ending 31st March 2026. Scanned copy of Certificate from CA with Unique Document Identification Number (UDIN) to be uploaded, in support of claim.

j) **Profit/Loss:**
Bidder should not have incurred any loss (profit after tax should be positive) in more than two years during the last five years ending 31st March 2026. (Standalone financial statement), duly audited and certified by the Chartered Accountant.

k) **Solvency Certificate:**
Bidder should submit a Solvency Certificate from a Scheduled Commercial Bank for Rs.**4.13 Crores** issued after 1st February, 2026 *as per* ***Form-B*** *of this tender document.*

NOTE:-

1. Only works executed in India shall be considered for similar work.

2. Qualified similar works shall be physically inspected by the SBI Officials/ Project Architect to ascertain the completion, performance on Quality of works for finalizing the technical bids.

3. If private work is shown in support of eligibility criteria, certified copy of Tax deducted at source (TDS) Certificate Form 16A and 26A shall be submitted along with the experience certificate and TDS amount shall tally with the actual amount of work done. Otherwise, the amount that tally with TDS shall only be considered for eligibility.

4. Work of specialized E&M services if executed under a separate contract may be considered for the purpose of assessing the technical competency only without adding its monetary value for determining the eligibility criteria.

5. Components of work executed other than those included in definition of similar work shall be deducted while calculating the cost of similar work. The bidder shall submit abstract of cost of work along with supporting documents and certificate issued by the experience issuing authority in support of this.

6. Completion of work for the purpose of considering experience shall mean completion of entire work in contract and not completion of some portion of the contract even though some portion may be satisfying the magnitude and physical attributes of similar work.

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PARAMETERS FOR TECHNICAL QUALIFICATION

PROPOSED INTERIOR FURNISHING OF BANKS OFFICE PREMISES AT VASHI, NAVI MUMBAI

BRIEF TECHNICAL PARAMETER FOR EVALUATION (TOTAL MARKS-80)

Sr. No.	Broad criteria/ Technical parameter and marks assigned to each parameter	Maximum Marks
1	Experience of the firm, Min 7 years =5 marks, more than 7 up to 10 years = 8 marks, more than 10 and up to 15 years =10 marks, more than 15 years = 15 marks	15
2	Maximum value (Composite Project Cost) of any single similar project completed in the last 7 years up to 31.03.2026, up to Rs 11 crores = 08, More than 11 crores and up to 20 Crores = 12, More than 20 crores = 15,	15
3	Performance Certificate from Existing Clients a. Excellent /Very Good = 15 b. Good = 10 c. Satisfactory /fair = 07 (Only similar eligible projects of highest value will alone be considered for this)	15
4	Having Electrical license = 10 Having electrical license of JV/ Association = 8	10
5	Having local office at Mumbai: Full Fledged Office= 10 marks, Branch Office = 07 marks, No. Office= 0 marks	10
6	Having valid ISO Certification = 05 Not possessing any ISO certification = 0	05
7	Site Visit of the similar eligible completed projects Excellent work /Very Good= 10 Good = 08 Satisfactory /fair = 5	10
	TOTAL	**80**

Note: The bidders scoring at least 70 % marks i.e 56 marks, will only be eligible for opening of their Price Bids.

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APPLICATION FORM

(Please read the Application Documents carefully before filling-up)
(Please strike-off which is not applicable)

1	Name of the Contractor / Firm	
2a	Full Postal Address of Contractor / Firm	
2b	Telephone & Mobile No.	
2c	Email ID	
3	Main Activities of Contractor / Firm (Please use additional sheet, if required)	
4	Year of establishment of Contractor/ Firm (Enclose certified copies of relevant documents)	
5	Constitution of Firm (Enclose certified copies of relevant documents)	Sole Proprietorship / LLP / Partnership/ Private Ltd. / Public Ltd. / Any other (Please specify)
6	Name of the Proprietor / Partners / Directors of the Organization / Firm.	1. 2. 3.
7a	Details of Authorized Signatory (i)Name of Authorized Signatory	
	(ii) Phone No.	
	(iii) Mobile No.	
	(iv) Email-ID	
7b	Mode of Authorization of Authorized signatory (Enclose certified copies of relevant documents as)	Resolution / Partnership Deed / Registered Power of Attorney /Proprietor/any other (please specify)

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8	Whether registered with the registrar of companies / Registrar of firms. If so, mention number and dates. (Enclose certified copies of relevant documents)	
9a	PAN No. (Income tax) (Enclose certified copies of relevant documents)	
9b	GST No. (Enclose certified copies of relevant documents)	
9c	PF Registration No. (Enclose certified copies of relevant document**s)**	
9d	ESIC Registration No. (Enclose certified copies of relevant documents as)	
10	If Registered in the Panel of other Organizations such as CPWD, PWD, MES, Banks etc. Mention Name of Organization, Registration No. & Date and Category (Enclose certified copies of relevant documents)	
11 a	Banker's Details: (Enclose certified copies of Cancelled Cheque) (i) Banker's Name	
	(ii) Full Postal Address of Branch	
	(iii) Telephone No.	
	(iv) Account No.	
	(v) Type of Account	
11 b	Solvency Limit (Enclose certified copies of relevant document**s)**	
12 a	Yearly turnover of the Firm during the last 03 financial years (Enclose copy of Affidavit / Certificate from Chartered Accountant mentioning turnover of last 03 financial years)	F.Y. 2025-26: F.Y. 2024-25: F.Y. 2023-24: F.Y. 2022-23: Average :

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12 b	Profit & Loss Statement of the last 03 financial years (Enclose self- certified one-page summarized balance sheet (audited) and one page of summarized Profit & Loss Account for the last 03 years collectively)	F.Y. 2025-26: F.Y. 2024-25: F.Y. 2023-24: F.Y. 2022-23:
13	Whether last three years IT returns filed (Please enclose certified copies of the IT Returns of 2022-23, 2023-24, 2024-25 and 2025-26 (unaudited)) (Enclose certified copies of relevant documents Certificates)	Yes / No
14	Details of similar works executed & completed. (Enclose certified copies of Work Completion Certificates)	Please fill up enclosed **Annexure-I** & enclose copies of Work Order & Work Completion Certificates)
15	Details of similar works on hand.	Please fill up enclosed **Annexure-II**
16	Please attach certified copies of Performance Report of at least 3 works referred to in Annexure-I	Attach Performance Reports duly filled- in & signed by the Competent Authority of the Client as per **Annexure-III**
17	Any other relevant information	Fill and attach as **Annexure-IV**
18	Name, Address, Email and Contact Nos. of at least 3 persons who are in position and competent to report about the quality and performance of your Firm. (These 3 persons should have been associated with any 3 completed similar works mentioned in Annexure-I).	
19	Details (including status) of all the disputes (including Litigation, Arbitration, Mediation etc.) pertaining to interior renovation Contracts between Applicant's Firm and Clients during the last 07 years (i.e. from 31.03.2018) (Please use additional sheet, if required)	
20	Details of all delisting / debarring / blacklisting / de-paneling etc. of the Applicant Firm by any Organization / Client during the last 07 years	
21	Details (Name, Designation, PF No.) of near relatives working in State Bank of India. (for definition of near relatives please refer Instructions, Terms and Conditions)	

(<u>Note:-</u> All Enclosures must be self-certified by Authorised Signatory)

1. I/We have read and understood all the contents of these Application Documents and are acceptable to us. I/We also certify that my/our firm fulfils the ELIGIBILITY CRITERIA for this work.

2. I/We hereby confirm and certify that the information given above are correct and true and the Annexures / Enclosures etc. enclosed herewith are genuine.

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3. I/We are authorized to sign and submit the Application Documents for pre- qualification.

4. I/We understand and agree that if at any stage it is found/ noticed by the Bank that any information provided by us is untrue / incorrect, partly or fully and / or concealed in these Application Documents and / or also in case of receipt of any adverse/ unsatisfactory report from previous or present clients/ Bankers, the Bank on its own discretion may reject application at any stage and/or may de-list us from PQ/Empanelment List and/or may take any other appropriate action.

5. I/We also understand and agree that partly / wrongly filled application and / or applications not on prescribed proforma and / or applications not accompanying relevant Documents / Enclosures / Annexures and Application Documents not signed by the Authorised Signatory and / or received after the due date and time are liable to be summarily rejected by the Bank at its own discretion.

6. I/We understand and agree that this is merely an application/ and does not entitle us to be necessarily pre-qualified by the Bank and/or invite us for participation intender process and Bank reserves the right to reject all and / or any application without assigning any reason thereof.

(Signature of Authorised Signatory) **(Seal of the Firm)**

Name: ……

Designation in Firm:……

Place: ……

Date ……

(Please ensure to enclose all annexures / enclosures / relevant documents etc with application documents before submitting)

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Annexure –'I'

COMPLETED WORKS

DETAILS OF ELIGIBLE SIMILAR NATURE OF WORKS COMPLETED DURING THE LAST SEVEN YEARS ENDING 31ST MARCH 2026.

Important - (Please mention all Amounts **without GST**)

S.No.	Particulars	Similar work - 1	Similar work – 2	Similar work – 3
1	Name of Work/Project			
2	Site Address			
3	Name of Client /Organization			
4	Name			
	Designation			
	Contact No.			
	Email Id			
	Address of Officer i/c of Client to whom reference can be made			
5 A	Estimated Cost as per Tender floated / issued	Rs. Crores	Rs. Crores	Crores
5 B	Contract Cost	Rs. Crores	Rs. Crores	Crores
6	Completion Cost	Rs. Crores	Rs. Crores	Crores
7	**Completion Cost of Interior works with Civil, Electrical, HVAC, Furniture etc.**			
8	No. of Floors			
9	Total Built up Area	Sq.Mt.	Sq.Mt.	Sq.Mt.
10	Total Carpet Area	Sq.Mt.	Sq.Mt.	Sq.Mt.

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11 A	Date of Start of Work as per Contract / Work Order			
11 B	Actual Date of Start of Work			
12 A	Scheduled date of Completion of work as per Contract			
12 B	Actual Date of Completion of Work			
13 A	Stipulated Period of Completion as per Contract (Months)			
13 B	Actual Time taken in Completion (in Months)			
14	Number of Authorized Extension granted by Client			
15	Reasons of Delay			
16	Penalty / LD Amount			
17	Details of Dispute / Litigation, if any			
18	Any other relevant information, if the applicant wants to furnish.			

Additional Sheets on the same format may be used, if required.

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Annexure –'II'

WORKS IN HAND

DETAILS OF ELIGIBLE SIMILAR NATURE OF WORKS IN HAND DURING THE LAST SEVEN YEARS ENDING 31ST MARCH 2026.

Important - (Please mention all Amounts **without GST**)

S.No.	Particulars	Similar work - 1	Similar work – 2	Similar work – 3
1	Name of Work/Project			
2	Site Address			
3	Name of Client/ Organization			
4	Name			
	Designation			
	Contact No.			
	Email Id			
	Address of Officer i/c of Client to whom reference can be made			
5 A	Estimated Cost as per Tender floated / issued	Rs. Crores	Rs. Crores	Rs. Crores
5 B	Contract Cost / Value	Rs. Crores	Rs. Crores	Rs. Crores
6	No. of Floors			
7	Total Built up Area	Sq.Mt.	Sq.Mt.	Sq.Mt.
8	Total Carpet Area	Sq.Mt.	Sq.Mt.	Sq.Mt.
9	Date of Start at site			
10	Present Status of Work / Progress at Site			

Additional Sheets on the same format may be used, if required.

Signature & Seal of Contractor

Annexure –'III'

PERFORMANCE REPORT

(Should be on letterhead of the client and should be signed and stamped by the client)

Important - (Please mention all Amounts **without GST**)

S.No.	Particulars	Details
1	Name of Work	
2	Location	
3	Estimated Cost	Rs.
4	Tendered Cost	Rs.
5	Actual Completion Cost	Rs.
6	Date of Start	
7 A	Stipulated Date of Completion	
7 B	Actual Date of Completion	
8	Any Liquidated Damages / Penalty / Levy decided, if Yes, Amount	Yes / No Rs.
9	Performance Report	Outstanding / Very Good / Good / Average / Poor
(i)	Quality of Work	Outstanding / Very Good / Good / Average / Poor
(ii)	Timely Execution	Outstanding / Very Good / Good / Average / Poor
(iii)	Integrity as regard to Working	Outstanding / Very Good / Good / Average / Poor
(iv)	Ease in settling Extra Items	Outstanding / Very Good / Good / Average / Poor
(v)	Resourcefulness	Outstanding / Very Good / Good / Average / Poor
(vi)	Technical Proficiency	Outstanding / Very Good / Good / Average / Poor
(vii)	Litigation	Yes / No
(viii)	General Behavior / Conduct	Outstanding / Very Good / Good / Average / Poor
10	Additional Information / Remarks	

Additional Sheets on the same format may be used, if required.

(Signature of Officer/Engineer Incharge) (Seal of the Client)
(Not below Ex. Engineer or Equivalent of the Client)
Designation: Date:

Signature & Seal of Contractor

Annexure –'III-A'

ASSESSEMENT OF QUALITY

FORMAT OF THE ASSESSEMENT OF QUALITY FOR COMPLETED AS WELL AS ON GOING WORKS (WOULD BE ASSESSED BY THE BANK ALONG WITH THE CONSULTANTS DURING THE STAGE OF PRE-QUALIFICATION / INSPECTION OF THE WORKS OF THE BIDDERS AS A PART OF THE DUE-DILIGENCE FOR ASSESSING THEIR CAPABILITIES)

Name of work:

Date of Inspection:

Date of submission of report:

(A) General Observation & Operational Aspects		**Yes/No**
1	Availability of approval from local bodies in case of Interior Works of Private Buildings	
2	Availability of approved Fire NOC & other necessary permissions	
3	Availability of As-built drawings with the Vendor	
4	Whether Line & level Maintained	
5	Quality of Shop drawings prepared by Contractors	
6	Any Structural defects/distress observed. If yes give details	
7	Whether safety measures/safety assurance plan adopted at site as per CPWD Safety Code and or govt. guidelines are adequate or not	
8	Whether the Welfare facilities provided to labour as per Govt. guidelines are adequate or not (documented proof to be m available)	
9	Whether AHU getting automatically switched off and fire damps closed in case of fire signal?	
10	Whether thimbles used for termination of wires in DBs, EBDs & Panels?	
(B) Quality of Work		**Mark Assessed**
1	Quality of plaster/finishing	
2	Quality of False Ceiling	
3	Quality of Flooring	
4	Quality of Wall Finishing	
5	Quality of junctions and terminations of various materials	
6	Quality of Stone Work	
7	Quality of Wood Work	
8	Quality of Steel Work/ Aluminium Work	
9	Quality of Plumbing and Sanitary Installation	
10	Quality of Workmanship	
11	Quality of Waterproofing	
12	If cladding done, observation on efficiency/Quality of cladding / Brick work	
13	Quality of internal electrification work	
14	Quality of DBs, EBDs &Panels	
15	Quality of E&M equipment's, panels & feeder pillar	

Signature & Seal of Contractor

16	Quality of fire alarm system/firefighting system	
17	Quality of Air Conditioning work	
18	Quality of Sub-station/electrical panel room based on complete live diagram, capacitor panel, power factor, insulating Mat, cleanliness, Cable termination, earthing pits, earthing of transformer/DG sets	
19	Any Other aspect (To be elaborated)	

Signature & Seal of Contractor

Annexure –IV

OTHER RELEVANT INFORMATION

Details of Technical Staff with Firm / Contractor				
A	Name of Manager / Engineer / Supervisor	Qualification	With Firm for how many years	Total Experience in Years
1				
2				
3				
4				
5				
6				
7				
8				
9				
Details of own Equipment etc with Firm / Contractors (Mixer / Batching Plant / Testing Equipment's / Shuttering / Centering etc.				
B	Name of Equipment	Unit (Nos / Sq. Mt. etc)	Quantity	Specifications / Quality
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

(Please Use additional sheets on same Format, if Required)

Signature & Seal of Contractor

FORM 'A' FINANCIAL INFORMATION

I. Financial Analysis: Details to be furnished duly supported by figures in balance sheet / profit & loss account for the **last five years duly certified and audited by the Chartered Accountant, as submitted by the applicant to the Income Tax Department (Copies to be attached):**

(Amounts - Rupees in Lakhs)

Sr. No.	Particulars	Financial Year				
		2021-22	2022-23	2023-24	2024-25	2025-26
i	Gross annual Turnover on interior renovation works					
ii.	Profit/Loss (standalone financial statement and consolidated financial statement both).					

II. Financial arrangements for carrying out the proposed work.

Signature of Chartered Accountant with Seal

Signature of Bidder(S)

FORM 'B'

FORM OF BANKERS' / SOLVENCY CERTIFICATE OF RECENT DATE I.E. ISSUED ATFER 1ST APRIL 2025 FROM A SCHEDULED COMMERCIAL BANK

To,
The Deputy General Manager (Premises),
State Bank of India, Corporate Centre,
9th Floor, State bank Bhawan, Nariman
Point, Mumbai-400 021.

No.: Date:

SOLVENCY CERTIFICATE

This is to certify that, to the best of our knowledge and information, M/s / Sri……..……., a customer of our bank, has been maintaining Savings Bank / Current Account bearing number……with our ……. ……. Branch, since …….. (Month and Year).
We understand from the customer that the certificate is for the purpose of Tender with your organisation. We further certify that M/s / Shri / Smt. ……...is solvent to the extent of INR …… (Rupees……...only).

This certificate issued by the Bank on the specific request of the customer and should be regarded as without any guarantee or liability, financial or otherwise, on the part of the Bank or its officials.

(Signature)
For the Bank

Note:
1. Bankers 'certificate should be original on the letter head of the Issuing Bank duly sealed in cover and addressed to enlistment authority.

2. In case of partnership firm, certificate to include names of all partners as recorded with the Bank.

FORM 'C'

To,
The Deputy General Manager (Premises),
State Bank of India,
Corporate Centre,
9th Floor, State bank Bhawan,
Nariman Point, Mumbai-400 021

Subject: Submission of bids for the work of Proposed Interior Works at 7th To 10th Floors of SBI Building at Vashi, Navi Mumbai.

Sir,

Having examined details given in press Notice and bid document for the above work, I/we hereby submit the relevant information:

"It is to certify that as per the audited balance sheet and profit & loss account during the financial year_____, the Net-worth of M/s _____ (Name & Registered address of the individual / firm / company), as on 31st March 2026 is Rs._____ after considering all liabilities. It is further certified that the Net-worth of the company has not eroded by more than 30% in the last three year ending on 31st March 2026."

(Signature of the Chartered Accountant)

Name of the Chartered Accountant

Membership no of ICAI

Date & Seal

FORM "D"

PROFORMA OF AFFIDAVIT FOR EXECUTION OF SIMILAR WORKS

I/We undertake and confirm that eligible similar works(s) has/have not been got executed through another contractor on back-to-back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred for bidding in State Bank of India in future forever. Also, if such a violation comes to the notice of State bank of India before date of start of work, the Deputy General Manager (Premises) shall be free to forfeit the entire amount of Earnest Money Deposit / Performance Guarantee.

(Scanned copy to be uploaded at the time of submission of bid)

NOTE: Affidavit to be furnished on a 'Non-Judicial' stamp paper worth Rs.100/-

Signature of Bidder(s) or an authorized

Officer of the firm with stamp

Signature of Notary with Seal

FORM "E"

PROFORMA OF AFFIDAVIT FOR NON - BLACK LISTING

I/we undertake and confirm that our firm/partnership firm has not been blacklisted by any State/Central Departments/PSUs/Autonomous bodies during the last 7 years of its operations. Further that, if such information comes to the notice of the State bank of India then I/we shall be debarred for bidding in State Bank of India in future forever. Also, if such an information comes to the notice of State Bank of India on any day before date of start of work, the Deputy General Manager (Premises) shall be free to cancel the agreement and to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee (Scanned copy of this notarized affidavit to be uploaded at the time of submission of bid)

NOTE: Affidavit to be furnished on a 'Non-Judicial' stamp paper worth Rs.100/-.

Signature of Bidder(s) or an authorized

Officer of the firm with stamp

Signature of Notary with seal

FORM 'F' STRUCTURE & ORGANIZATION

1	Name & Address of the bidder	
2	Telephone No. / Email id / Telex No./ Fax No.	
3	Legal status of the bidder (attach copies of original document defining the legal status) (a) An Individual (b) A proprietary firm (c) A firm in partnership (d) A limited company or Corporation	
4	Particulars of registration with various Government Bodies (attach attested photocopy).	
	Organization/Place of Registration	Registration No.
(i)		
(ii)		
(iii)		
5	Names and Titles of Directors & Officers with designation to be concerned with this work	
6	Designation of individuals authorized to act for the organization	
7	Has the bidder or any constituent partner in case of partnership firm, ever abandoned the awarded work before its completion? If so, give name of the project and reasons for abandonment.	
8	Has the bidder or any constituent partner in case of partnership firm/ Limited company /Joint venture, ever been convicted by the court of law? If so, give details	
9	In which field of Civil Engineering/ Construction/ Interiors, the bidder has specialization and interest?	
10	Any other information considered necessary but not included above	

Signature of bidder(s)

LETTER OF TRANSMITTAL INFORMATION REGARDING ELIGIBILITY

From:
.....
.....
.....
To :
The Deputy General Manager (Premises),
State Bank of India, Corporate Centre,
9h Floor, State bank Bhawan,
Nariman Point, Mumbai-400 021

Subject: Submission of bids for the work of Proposed Interior Works at 7th to 10th Floors of SBI building at Vashi, Navi Mumbai.

Sir,

Having examined details given in press Notice and bid document for the above work, I/we hereby submit the relevant information.

1. I/We hereby certify that all the statements made and information supplied in the enclosed forms A to E and accompanying statement are true and correct.
2. I / we have furnished all information and details necessary for eligibility and have no further pertinent information to supply.
3. I/ we submit the requisite certified Banker's certificate and authorize the **Deputy General Manager (Premises)** to approach the Bank issuing the Banker's certificate to confirm the correctness thereof. I/We also authorize **Deputy General Manager (Premises)** to approach individuals, employers, firms and corporation to verify our competence, work experience, and general reputation.
4. I/we submit the following certificates in support of our suitability, technical knowledge and capability for having successfully completed the following eligible similar works:

Name of Work	Certificate from

Certificate:

It is certified that the information given in the enclosed eligibility bid are correct. It is also certified that I/We shall be liable to be debarred, disqualified/ cancellation of enlistment in case any information furnished by me/us found to be incorrect.

Enclosures:

Date of submission: Seal & Signature of bidder(s)

LETTER OF UNDERTAKING

The Deputy General Manager (Premises),
Global Markets,
State Bank of India, Corporate Centre,
14th Floor, State bank Bhawan,
Nariman Point, Mumbai-400 021

Dear Sir,

Having examined the drawings, specification, design and schedule of quantities relating to the works specified in the memorandum hereinafter set out and having visited and examined the site of the works specified in the said memorandum and having acquired the requisite information relating thereto as affecting the tender, I/We hereby offer to execute the works specified in the said memorandum at the rates mentioned in the attached Schedule of Quantities and in accordance in all respects with the specifications, design, drawings and instructions in writing referred to in conditions of tender, the Articles of Agreement, Special Conditions, Schedule of Quantities and Conditions of Contract and with such materials as are provided for by, and in all other respects in accordance with such conditions so far as they may be applicable.

MEMORANDUM

(a)	Description of work	Tender for **Proposed Interior Works at 7th to 10th Floors of SBI building at Vashi, Navi Mumbai**
(b)	Earnest Money	**Rs.13,78,000/- (Rupees Thirteen Lakh Seventy Eight Thousand Only)** by means of Demand Draft / Pay Order (Valid for a period of 90 Days from the last date of submission of the tender) from any scheduled Nationalized Bank drawn in favour of Deputy General Manager (Premises), State Bank of India payable at Mumbai.
(c)	Time allowed for completion of the Works	**03 months (Including monsoon and public holidays).**

1) Should this tender be accepted, I/we hereby agree to abide by and fulfill the terms and provisions of the said conditions of contract annexed hereto so far as may be applicable or in default thereof to forfeit and pay to SBI, the amount mentioned in the said contract.

2) I / We have deposited a sum of **Rs.13,78,000/- (Rupees Thirteen Lakh Seventy Eight Thousand Only)** as Earnest Money with SBI which amount is not to bear any interest. Should I / We fail to execute the Contract when called upon to do so, I / we do hereby agree that this sum shall be forfeited by me/us to SBI.

3) I/ We have read and understood various clauses of this tender and hereby submit our specific undertaking and concurrence in terms of the relevant clause of "Instruction to tenderer" to ***Additional Security deposit*** *(ASD)/*Additional performance Guarantee (APG) shall be applicable if the bid price is **below 10 % of the estimated cost put to tender**. The amount of such ASD/ APG shall be the difference between 90 % of estimated cost put to tender and the quoted price, as a performance guarantee for due fulfilment of our contractual obligation for the project. Further,

under any circumstances, whatsoever, if I/We fail to comply the same including compliance of any such other conditions of tender within the stipulated time. I /We hereby, authorized SBI to cancel my/Our tender, to forfeit my EMD/ISD/ASD and to take further necessary action as deemed fit including debarring our firm from participating in SBI future tenders/de-paneling etc.

4) I/ We understand that as per terms of this tender, SBI may consider accepting our tender in part or whole or may entrust the various work proposed in phases. We, therefore, undertake that we shall not raise any claim/ compensation in the eventuality of Bank deciding to drop any of the work from the scope of work of this tender at any stage during the contract period. Further, we also undertake to execute the work entrusted to us in phases on our approved percentage and within stipulated time limit without any extra claim for price escalation as also provided for in the clause pertaining to the "Instructions to Tenderers" of this tender.

5) I/ We, hereby, undertake that, we will obtain necessary statutory approvals/ necessary permission from relevant Govt/ competent authority in consultation with Project Architect for carrying-out the captioned project works time-to-time on behalf of the Bank. For the purpose, Bank will reimburse the statutory charges/ cost as actual, on production of tax receipts/ invoices in original by us.

6) I/ We, hereby, also undertake that, we will not raise any claim for any escalation in the prices of any of the material during the currency of contract/execution/completion period including authorized extended contract period, if any.

7) Our Bankers are:
i)
ii)

Name of the partner of the firm
Authorised to sign
Or
(Name of person having Power of Attorney to sign the Contract. (Certified true copy of the Power of Attorney should be attached)

Yours faithfully,
Signature of Contractors.

Signature and addresses of Witnesses
i)
ii)

INTEGRITY AGREEMENT

TO BE SIGNED BY THE BIDDER AND SAME SIGNATORY COMPETENT / AUTHORIZED TO SIGN THE RELEVANT CONTRACT WITH STATE BANK OF INDIA

This Integrity Agreement is made at ..... on this ..... day of .....20.....

BETWEEN

State bank of India represented through Deputy General Manager (Premises), Global Markets, Corporate Centre, Nariman Point, Mumbai 400051 (Hereinafter referred as the '**Principal/Owner**', which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

AND

..... (Name and Address of the Individual / firm/ Company) ……. through ..... (Hereinafter referred to as the (Details of duly authorized signatory) "**Bidder/Contractor**" and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns).

PREAMBLE:

WHEREAS the Principal / Owner has floated the Tender (NIT No. .....) (hereinafter referred to as "**Tender/Bid**") and intends to award, under laid down organizational procedure, contract for **"C/o ……..."**hereinafter referred to as the "**Contract**".

AND WHEREAS the Principal/Owner values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relation with its Bidder(s) and Contractor(s).

AND WHEREAS to meet the purpose aforesaid both the parties have agreed to enter into this Integrity Agreement (hereinafter referred to as "**Integrity Pact**" or "**Pact**"), the terms and conditions of which shall also be read as integral part and parcel of the Tender/Bid documents and Contract between the parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the parties hereby agree as follows and this Pact witness as under:

ARTICLE 1: Commitment of the Principal/Owner

1) The Principal/Owner commits itself to take all measures necessary to prevent corruption and to observe the following principles:

(a) No employee of the Principal/Owner, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

(b) The Principal/Owner will, during the Tender process, treat all Bidder(s) with equity and reason. The Principal/Owner will, in particular, before and during the Tender process, provide to all Bidder(s) the same information and will not provide to any Bidders(s) confidential/additional information through which the Bidder(s) could obtain an advantage in relation to the Tender process or the Contract execution.

(c) The Principal/Owner shall endeavour to exclude from the Tender process any person, whose conduct in the past has been of biased nature.

2) If the Principal/Owner obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal code (IPC)/Prevention of Corruption Act, 1988 (PC Act) or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Principal/Owner will inform the Chief Vigilance Officer and in addition can also initiate disciplinary actions as per its internal laid down policies and procedures.

ARTICLE 2: Commitment of the Bidder(s)/Contractor(s)

1) It is required that each Bidder/Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the Government/Department all suspected acts of **fraud or corruption or Coercion or Collusion** of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation or award of a contract.

2) The Bidder(s)/Contractor(s) commits himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the Tender process and during the Contract execution:

a) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal/Owner's employees involved in the Tender process or execution of the Contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender process or during the execution of the Contract.
b) The Bidder(s)/Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to cartelize in the bidding process.
c) The Bidder(s)/Contractor(s) will not commit any offence under relevant IPC/PC Act. Further the Bidder(s)/Contract(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Principal/Owner as part of the business relationship, regarding plans, technical proposals and business details including information contained or transmitted electronically.
d) The Bidder(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/representatives in India, if any. Similarly, Bidder(s)/Contractor(s) of Indian Nationality shall disclose names and address of foreign agents/representatives, if any. Either the India agent on behalf of the foreign principal or the foreign principal directly could bid in a tender but not both. Further, in cases where an agent participates in a tender on behalf of one manufacturer, he shall not be allowed to quote on behalf of another manufacturer along with the first manufacturer in a subsequent/parallel tender for the same item.
e) The Bidder(s)/Contractor(s) will, when presenting his bid, disclose (with each tender as per proforma enclosed) any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the Contract.

3) The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

4) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice **means a willful misrepresentation or omission of facts or submission of fake/forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to detriment of the Government interests**.

5) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm use Coercive Practices (means the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his/her reputation or property to influence their participation in the tendering process).

ARTICLE 3: Consequences of Breach

Without prejudice to any rights that may be available to the Principal/Owner under law or the Contract or its established policies and laid down procedures, the Principal/Owner shall have the following rights in case of breach of this Integrity Pact by the Bidder(s)/Contractor(s) and the Bidder/Contractor accepts and undertakes to respect and uphold the Principal/Owner's absolute right:

1) If the Bidder(s)/Contractor(s), either before award or during execution of Contract has committed a transgression through a violation of Article 2 above or in any other form, such as to put his reliability or credibility in question, the Principal/Owner after giving 14 days' notice to the contractor shall have powers to disqualify the Bidder(s)/Contractor(s) from the Tender process or terminate/determine the Contract, if already executed or exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of transgression and determined by the Principal/Owner. **Such exclusion may be forever or for a limited period as decided by the Principal/Owner**.

2) **Forfeiture of EMD/Performance Guarantee/Security Deposit**: If the Principal/Owner has disqualified the Bidder(s) from the Tender process prior to the award of the Contract or terminated/determined the Contract or has accrued the right to terminate/determine the Contract according to Article 3(1), the Principal/Owner apart from exercising any legal rights that may have accrued to the Principal/Owner, may in its considered opinion forfeit the entire amount of Earnest Money Deposit, Performance Guarantee and Security Deposit of the Bidder/Contractor.

3) **Criminal Liability**: If the Principal/Owner obtains knowledge of conduct of a Bidder or Contractor, or of an employee or a representative or an associate of a Bidder or Contractor which constitutes corruption within the meaning of Indian Penal code (IPC)/Prevention of Corruption Act, or if the Principal/Owner has substantive suspicion in this regard, the Principal/Owner will inform the same to law enforcing agencies for further investigation.

ARTICLE 4: Previous Transgression

1) The Bidder declares that no previous transgressions occurred in the last 5 years with any other Company in any country confirming to the anticorruption approach or with Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify his exclusion from the Tender process.

2) If the Bidder makes incorrect statement on this subject, he can be disqualified from the Tender process or action can be taken for banning of business dealings/holiday listing of the Bidder/Contractor as deemed fit by the Principal/Owner.

3) If the Bidder/Contractor can prove that he has resorted/recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal/Owner may, at its own discretion, revoke the exclusion prematurely.

ARTICLE 5: Equal Treatment of all Bidders/Contractors/Subcontractors

1) The Bidder(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact. The Bidder/Contractor shall be responsible for any violation(s) of the principles laid down in this agreement/Pact by any of its Sub-contractors/sub-vendors.

2) The Principal/Owner will enter into Pacts on identical terms as this one with all Bidders and Contractors.
3) The Principal/Owner will disqualify Bidders, who do not submit, the duly signed Pact between the Principal/Owner and the bidder, along with the Tender or violate its provisions at any stage of the Tender process, from the Tender process.

ARTICLE 6: Independent External Monitors (IEM)

1) The Principal/Owner has appointed IEM for this Pact as per Central Vigilance Commission order no 41/12/07 (Names and Addresses of the IEM to be given below).

NAME	**Shri. Satyajit Mohanty**	**Smt. Rashmi Verma**
CADRE	IPS (Retd.)	IAS (Retd.)
E-mail ID	**satyajitmohanty88@gmail.com**	**Rashmi.naveenverma@gmail.com**

2) The task of the IEM shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.

3) The IEM shall not be subject to instructions by the representatives of the parties and perform their functions neutrally and independently.

4) Both the parties accept that the IEM have the right to access all the documents relating to the project/procurement, including minutes of meetings.

5) As soon as the IEM notices, or has reason to believe, a violation of this Pact, he will so inform the Authority designated by the Principal/Owner.

6) The BIDDER(s) accepts that the IEM has the right to access without restriction to all Project documentation of the Principal/Owner including that provided by the BIDDER. The BIDDER will also grant the IEM, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The IEM shall be under contractual obligation to treat the information and documents of the BIDDER/ Subcontractor(s) with confidentiality.

7) The Principal/Owner will provide to the IEM sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the parties. The parties will offer to the IEM the option to participate in such meetings.

8) The IEM will submit a written report to the designated Authority of Principal/Owner /Secretary in the Department/ within 8 to 10 weeks from the date of reference or intimation to him by the Principal/ Owner / BIDDER and, should the occasion arise, submit proposals for correcting problematic situations.

ARTICLE 7: Facilitation of Investigation

In case of any allegation of violation of any provisions of this Pact or payment of commission, the Principal/ Owner or its agencies shall be entitled to examine all the documents including the Books of Accounts of the BIDDER and the BIDDER shall provide necessary information and documents in English and shall extend all possible help for the purpose of such examination.

ARTICLE 8: Duration of the Pact

This Pact begins when both the parties have legally signed it. It expires for the Contractor/Vendor, 60 months (5 years) after the completion of work under the contract or till the continuation of defect liability period, whichever is more and for all other bidders, till the Contract has been awarded. If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pacts as specified above, unless it is discharged/determined by the Competent Authority, SBI.

ARTICLE 9: Other Provisions

1) This Pact is subject to Indian Law, place of performance and jurisdiction is **Mumbai, / location** of the Principal/Owner, who has floated the Tender.

2) Changes and supplements need to be made in writing. Side agreements have not been made.
3) If the Contractor is a partnership or a consortium, this Pact must be signed by all the partners or by one or more partner holding power of attorney signed by all partners and consortium members. In case of a Company, the Pact must be signed by a representative duly authorized by board resolution.
4) Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intensions.
5) It is agreed term and condition that any dispute or difference arising between the parties with regard to the terms of this Integrity Agreement/Pact, any action taken by the Owner/Principal in accordance with this **Integrity Agreement / Pact or interpretation thereof shall not be subject to arbitration**.

ARTICLE 10: LEGAL AND PRIOR RIGHTS

All rights and remedies of the parties hereto shall be in addition to all the other legal rights and remedies belonging to such parties under the Contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact will have precedence over the Tender/Contract documents with regard any of the provisions covered under this Integrity Pact.

IN WITNESS WHEREOF the parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses:

……..……	……..…….
(For and on behalf of Bidder/Contractor)	(For and on behalf of Principal/Owner)

Date:

Place:

WITNESSES:

1. …….
(Signature, name and address)

2. ……
(Signature, name and address)

INFORMATION TO THE BIDDERS

1.0 General:

1.1 Letter of transmittal and forms for deciding eligibility are given in Section III.

1.2 **All information called for in the enclosed forms should be furnished against the relevant columns** in the forms. If for any reason, information is furnished on a separate sheet, this fact should be mentioned against the relevant column. Even, if no information is to be provided in a column, a **'nil'** or **'no such case'** entry should be made in that column. If any particulars/query is not applicable in case of the bidder, it should be stated as **'Not applicable'**. The bidders are cautioned that not giving complete information called for in the application forms or not giving it in clear terms or making any change in the prescribed forms (or) deliberately suppressing the information may result in the bid being summarily disqualified. Bids shall be submitted online only and those received in physical form, by telegram or telex and those received late will not be entertained.

1.3 The bid should be type written. The bidder should sign each page of application, forms and documents before scanning & uploading.

1.4 Over writing should be avoided. Corrections if any should be made by neatly crossing out, initialing, dating and rewriting. Pages of the eligibility criteria document are numbered. Additional Sheets if any added by the Bidder should also be numbered by him. They should be submitted as a package with signed letter of transmittal.

1.5 References, information and certificate from the respective clients certifying suitability, technical knowledge or capability of the bidder should be signed by an officer not below the rank of Executive Engineer or equivalent.

1.6 The bidder may furnish any additional information, which he thinks is necessary to establish his capabilities to successfully complete envisaged work. He is, however advised not to furnish superfluous information. No information shall be entertained after submission of eligibility criteria document unless it is called for by the Employer.

2.0 Definitions:

2.1 In this document the following words and expression have their meaning here by assigned to them.

2.2 Employer: Means the State Bank of India, having its office at Premises Department, 9th Floor, Corporate Centre, Nariman Point, Mumbai 400 021.

2.3 Bidder: Means the individual, proprietary firm, firm in partnership, limited company (private or public) or corporation.

2.4 "Year" means "Financial year" unless stated otherwise.

3.0 Method of Application:

3.1 If the bidder is an individual, the application shall be signed by him above his/her full type written name and current address.

3.2 If the bidder is a proprietary firm; the application shall be signed by the proprietor above his/her full type written name and the full name of his firm with its current address.

3.3 If the bidder is a firm in partnership, the application shall be signed by all the partners of the firm above their full type written names and current addresses or alternatively by a partner holding power of attorney for the firm. In the latter case a certified copy of the power of attorney should accompany the application. In both the cases a certified copy of the partnership deed and current address of all the partners of the firm should accompany the application.

3.4 If the bidder is a limited company or a corporation, the bid shall be signed by a duly authorized person holding power of attorney for signing the application and certified copy of such power of attorney shall also be furnished. The bidder should also furnish a copy of memorandum of articles of association duly attested by a Public Notary.

4.0 Final Decision-Making Authority:

The Employer reserves the right to accept or reject any bid and to annul the process and reject all bids at any time without assigning any reason or incurring any liability to the bidders.

5.0 Particulars – Provisional:

The particulars of the work given in relevant section are provisional. They are liable to change and must be considered only as advance information to assist the bidder.

6.0 Site Visit:

The bidder is advised to visit the site of work, at his own cost, and examine it and its surroundings to himself collect all information that he considers necessary for proper assessment of the prospective assignment. Intending Bidders are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their bids as to the nature of the ground and sub-soil (so far as is practicable), the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect their bid. A bidder shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed. The bidder shall be responsible for arranging and maintaining at his own cost all materials, tools & plants, water, electricity access, facilities for workers and all other Services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a bid by a bidder implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work to be done and of conditions and rates at which stores, tools and plant, etc. will be issued to him by the Government and local conditions and other factors having a bearing on the execution of the work.

7.0 Initial Criteria for Eligibility:

The Firms / Contractors applying must fulfil each of the following criteria as interior renovation firm. The applications of the firms/contractors not fulfilling the following criteria will not be considered for prequalification.

The Companies / Firms that fulfill the criteria as given below shall be eligible:

a) i. The Company should be either a Partnership or a Public Limited Company or a Private Limited Company or Proprietorship firm registered under the Indian Companies Act 1956.

ii. The Company / Firm should have registration with Central/ State Govt. bodies / Public sector Undertakings, PSB's / Nationalized Banks / MES / Railway etc.

b) The firm / company should have an experience of minimum **07**years in relevant field i.e. interior renovation of offices as on **31.03.2026**.

c) The firm / company should have registration with GST, PF, ESIC, PAN No. and Prof. Tax etc. (as applicable) submit the proof of the same.

d) The firm should produce acknowledgement, and copy returns of IT for the last three years.

e) The firm should have current and valid Electrical Contractor license issued by relevant Government Authorities.

f) **Bidders / Contractors** who fulfill the following requirements shall be eligible to apply. Joint ventures are not accepted.

g) The bidder should have satisfactorily completed the works mentioned below during the last **7(seven) years** ending on **31.03.2026:**

At least one similar project of minimum **Rs.11.02 Crores** each or two similar projects **of minimum Rs.6.89 Crores** each or three similar projects of minimum **Rs.5.51 Crores** each during **last 7 years ending on 31.03.2025**. These Interior Works projects should be **Commercial Building projects,** and the value of work mentioned is excluding GST.

"Similar Works": - The definition of similar work shall mean completed Interior Renovation Works which should include Civil, Interior, Furniture Plumbing Sanitary, Waterproofing, HVAC, Electrical, IT, CCTV works etc (all the components executed under single contract) executed for Commercial buildings for Central Govt. Dept./State Govt. Dept./ Semi Govt. Dept. / PSU / Public sector Banks / Reputed Private Sector Organisations listed on Stock Exchange/ NSE/ BSE during last 7 years as on 31.03.2026". Please refer brief description of work contained in this document. The work order and the completion certificate shall clearly indicate works completed pertaining to the above-mentioned services and as such the break-up thereof, which has to satisfy the minimum works qualifying criteria.

h) **Average Annual Financial Turnover:**
Bidder should have had Average Annual Financial Turnover of **Rs. 4.13 Crores** interior renovation works during the last three years. Scanned copy of Certificate from CA with Unique Document Identification Number (UDIN) to be uploaded, in support of claim.

i) **Profit/Loss:**
Bidder should not have incurred any loss (profit after tax should be positive) in more than two years during the last five years ending 31st March 2025. (Standalone financial statement), duly audited and certified by the Chartered Accountant.

j) **Solvency Certificate:**
Bidder should submit a Solvency Certificate from a Scheduled Commercial Bank for Rs.**4.13 Crores** issued after 1st February, 2026 *as per* ***Form-B*** *of this tender document.*

NOTE:-

1. Machine room and Mumty shall not be counted as a storey.
2. Basement, Stilt constructed in the building shall be considered as storeys.
3. Only works executed in India shall be considered for similar work.
4. Qualified similar works shall be physically inspected by the SBI Officials/ Project Architect to ascertain the completion, performance on Quality of works for finalizing the technical bids.
5. If private work is shown in support of eligibility criteria, certified copy of Tax deducted at source (TDS) Certificate Form 16A and 26A) shall be submitted along with the experience certificate and TDS amount shall tally with the actual amount of work done. Otherwise, the amount that tally with TDS shall only be considered for eligibility.
6. Work of specialized E&M services if executed under a separate contract may be considered for the purpose of assessing the technical competency only without adding its monetary value for determining the eligibility criteria.

7. Components of work executed other than those included in definition of similar work shallbe deducted while calculating the cost of similar work. The RCC framed structure shall be of RCC slab, beams & columns. The bidder shall submit abstract of cost of work along with supporting documents and certificate issued by the experience issuing authority in support of this.
8. Completion of work for the purpose of considering experience shall mean completion of entire work in contract and not completion of some portion of the contract even though some portion may be satisfying the magnitude and physical attributes of similar work.

8.0 Even though any bidder may satisfy the above requirements, he would be liable to disqualification if he has:

(a) Made misleading or false representation or deliberately suppressed the information in the forms, statements and enclosures required in the eligibility criteria document.
(b) Record of poor performance such as abandoning work, not properly completing the contract, or financial failures/weaknesses etc.

9.0 Financial Information:

Bidder should furnish the Annual financial statement for the last Five years in **Form 'A'** and Solvency Certificate from Scheduled Commercial Bank as per **Form 'B'**

10.0 Experiences in Works Highlighting Experience in Similar Works:

10.1 Bidder should furnish list of all eligible similar nature of works successfully completed during last **Seven years** in **Annexure- 'I'**, and ongoing works on **Annexure- 'II'**

10.2 Performance report of each work referred to in **Annexure- 'I'** certified by an officer not below the rank of Executive Engineer / Project Manager or equivalent in **Annexure- 'III'** and ongoing works in **Annexure- 'III-A'**.

10.3 If eligible similar nature of works is executed for private firms, certified copy of the tax deducted at source certificate (TDS) and Form 26AS shall also be furnished along with the Performance report.

11.0 Organization Information:

Bidder is required to submit the information in respect of his organization in **Form- 'F'.** The bidder should have sufficient number of Technical and Administrative employees for the proper execution of the contract. The bidder should submit a list of these employees stating clearly how these would be involved in this work within 15 days of award of work.

12.0 Construction Plant & Equipment:

Bidders should furnish the list of construction plant and equipment including steel shuttering, centering and scaffolding to be used in carrying out the work. Details of any other plant & equipment required for the work not included in agreement and available with the bidder may also be indicated.

13.0 Letter of Transmittal:

The Bidder should submit the letter of transmittal attached with the document.

14.0 Opening of Price Bid:

After evaluation of applicants, a list of shortlisted agencies will be prepared. Thereafter the financial bids of only the qualified and technically acceptable bidders shall be opened and conducted at the notified time, date and place (to be notified on e-tender website) in the presence of the qualified bidders or their representatives. The bid shall remain **valid for 90 (Ninety) days** from the date of opening of Technical bid (eligibility bid).

15.0 Award criteria:

15.1 The employer reserves the right, without being liable for any damages or obligation to inform the bidder to:

(a) Amend the scope and value of contract to the bidder.
(b) Reject any or all the applications without assigning any reason.

15.2 Any effort on the part of the bidder or his agent to exercise influence or to pressurize the employer would result in rejection of his bid. Canvassing of any kind is prohibited.

INSTRUCTIONS TO THE TENDERERS

1.0 Scope of work

E-tenders are invited by SBI, Corporate Centre, Nariman Point, Mumbai for **Proposed Interior Works at 7th to 10th Floors of SBI building at Vashi, Navi Mumbai**.

1. Site and its location

The proposed work is to be carried out at **7th to 10th Floors of SBI premises at NMMC C-Ward building, Vashi, Navi Mumbai**.

2.0 Tender documents

2.1 The work has to be carried out strictly according to the conditions stipulated in the tender consisting of the following documents and the most workmen like manner.

- Instructions to tenderers
- General conditions of Contract
- Special conditions of Contract
- Additional Conditions for Electrical Installation
- Technical Specifications
- Drawings
- Price bid

2.2 The above documents shall be taken as complementary and mutually explanatory of one another but in case of ambiguities or discrepancies, shall take precedence in the order given below:

- Price bid
- Technical Specifications
- Additional Conditions, if any, for specialized trades such as Electrical Installation
- General conditions of Contract
- Special conditions of Contract
- Instructions to tenderers

2.3 Complete set of tender documents including relative drawings can be downloaded from the Bank's website during the period mentioned in the NIT.

2.4 The tender documents are not transferable.

3.0 **Site Visit**

3.1 The tenderer must obtain himself on his own responsibility and his own expenses all information and data which may be required for the purpose of filling this tender document and enter into a contract for the satisfactory performance of the work. The Tenderer is requested satisfy himself regarding the availability of water, power, transport and communication facilities, the character quality and quantity of the materials, labour, the law & order situation, climatic conditions local authorities requirement, traffic regulations etc;

The tenderer will be fully responsible for considering the financial effect to any or all the factors while submitting his tender.

4.0 **Earnest Money**

4.1 The tenderers are requested to submit the Earnest Money of **Rs.13,78,000/- (Rupees Thirteen Lakh Seventy Eight Thousand Only)** by means of Demand Draft / Pay Order (Valid for a period of 90 Days from the last date of submission of the tender) from any Scheduled Nationalized Bank drawn in favour of Deputy General Manager (Premises), State Bank of India, payable at Mumbai.

4.2 EMD in any other form other than as specified above will not be accepted. Tender not accompanied by the EMD in accordance with clause 4.1 above shall be rejected.

4.3 No interest will be paid on the EMD.

4.4 EMD of unsuccessful tenderer will be refunded within 30 days of award of Contract.

4.5 EMD of successful tenderer will also be returned on receipt of Initial Security Deposit.

5.0 **Initial Security Deposit**

The successful tenderer will have to submit a sum equivalent to 2% of accepted tender value in favour of SBI within a period of 15 days of acceptance of tender. EMD will be returned on receipt of Initial security Deposit.

6.0 Security Deposit

6.1 Total security deposit shall be 5% of contract value. Out of this 2% of contract value is in the form of Initial Security Deposit (ISD) which includes the EMD. Balance 3% shall be deducted from the running account bill of the work at the rate of 10% of the respective running account bill i.e., deduction from each running bill account will be @10% till Total Security Deposit (TSD) including ISD reaches to 5% of contract value. The 50% of the Total Security Deposit shall be paid to the contract on the basis of Architect's certifying the virtual completion. The balance 50% would be paid to the contractors after the defects liability period as specified in the contract.

6.2 No interest shall be paid to the amount retained by the Bank as Security Deposit.

6.3 Retention money shall be deducted as mentioned in clause no. 1.0.C (page no. 60)

6.3 **Additional Security Deposit**: -Additional Security deposit (ASD)/Additional performance Guarantee (APG) shall be applicable if the bid price is below 10 % of the estimated cost put to tender. The amount of such ASD/ APG shall be the difference between 90 % of estimated cost put to tender and the quoted price.

7.0 **Signing of contract Documents**

The successful tenderer shall be bound to implement the contract by signing an agreement and conditions of contract attached herewith within 15 days from the receipt of intimation of acceptance of the tender by the Bank. However, the written acceptance of the tenders by the Bank will constitute a binding agreement between the Bank and successful tenderer whether such formal agreement is subsequently entered into or not.

8.0 **Completion Period**:

The time period allowed for completion of the project shall be **3 months (Including monsoon and public holidays)** from the date of commencement of work or 15 days from the date of issuance of work order, whichever is earlier.

9.0 **Validity of tender**

Tenders shall remain valid and open for acceptance for a period of 3 (Three) Months days from the date of opening price bid. If the tenderer withdraws his/her offer during the value period or makes modifications in his/her original offer which are not acceptable to Bank without prejudice to any other right or remedy the Bank shall be at liberty forfeit the EMD.

10.0 **Liquidated Damages**

The liquidated damages shall be 0.50% per week subject to a maximum of 5% of contract value.

11.0 **Rate and Prices**

11.1 In case of percentage tender

11.1.1 The Tenderers shall quote percentage above / below / at par (in figures as well as in words) on the total estimated cost given in Schedule of Quantities, he will be willing to execute the work.

11.1.2 In percentage rate tenders only percentage quoted shall be considered. Any tender containing item rates is liable to be rejected. Percentage quoted by the tenderer in percentage rate tender shall be accurately filled in figures and works, so that there is no discrepancy.

11.1.3 The tender submitted shall be treated as invalid if the contractor does not quote percentage above / below / at par on the total amount of tender.

11.1.4 If the percentage above / below / at par is different in figures & words on the total amount of tender than amount quoted in words will be considered.

11.1.5 The rate and amount mentioned in the Schedule of Quantities will be in Indian Currency (₹) only and will be firm and include all costs, allowances etc. except GST, which will be payable / reimbursed at actuals.

11.1.6 The SBI reserve their rights to accept any tenders, either in whole or in part or may entrust the work in phases or may drop the part scope of work at any stage of the project or get the works done through another contractor at the cost of the accepted tenderer within its sole discretion without assigning any reason(s) for doing so and no claim / correspondence shall be entertained in this regard.

11.1.7 In case it is decided by the SBI to reduce the scope of work at any stage of the project, the contractor shall not be entitled to raise any claim / compensation on account of reduction in scope of work. Also, the SBI may consider for increase in scope of similar work in other buildings in phases but within a reasonable time interval and the contractor shall be bound to execute the same within the stipulated time period and as per rates quoted by them in this tender without any claim for price escalation.

BRIEF PARTICULARS OF THE WORK

Salient details of the work for which tenders are invited are as under:

Name of work: Proposed Interior Works at 7th to 10th Floors of SBI building at Vashi, Navi Mumbai

Estimated Cost: **Rs. 14,35,81,055.00** (Rupees: **Fourteen crores Thirty-Five lakhs Eighty-One thousand Fifty Five only.)**
Interior & Furniture Works: Rs. 8,76,02,552.00
Electrical Works: - Rs. 2,30,68,242.00
HVAC Works: - Rs. 1,99,14,842.00
Fire & Security System Works: - Rs. 1,30,09,219.00

Time Period: **03 months (Total duration of the contract) (Including monsoon and public holidays)**

1. The work is situated at **7th to 10th Floors of SBI premises at NMMC C-Ward building, Vashi, Navi Mumbai**.

BRIEF PARTICULARS OF THE PROPOSED PROJECT /WORK DESCRIPTION:

Location-7th to 10th Floors of SBI premises at NMMC C-Ward building, Vashi, Navi Mumbai.

It is proposed for **7th to 10th Floors of SBI premises** Interior Renovation works of a Commercial Building for State Bank of India has approx. 30,000 Sqft, at **NMMC C-Ward building, Vashi, Navi Mumbai** with state of the art features. The Site consists of multi-storied Commercial Building (Ground+10). Emphasis would be to make the project to achieve IGBC rating with all material and other parameters covered under IGBC, which are to be followed. Brief description of the proposed Interior Renovation works is as below:

a) Interior Renovation works.

2. General features and major important components of the work are listed as under:

(A) Civil And Interior Work-

1.Demolition and removal of existing furniture
2.Masonry work in AAC Blocks & plastering
3.Water proofing work
4.Plumbing and sanitary fittings
5.Flooring & dado works in Vitrified Tiles, Italian Marble,
6.Woodworks, wall lining, carpentry works
7.False ceiling In Gypsum, Modular ceiling,
8.Painting & finishing works
9.Partition works in toughened glass, Laminate, Veneer, Gypsum
10.Miscellaneous works Like Vertical, Roller Blinds
11.Carpentary works like Desks, Storages in Laminate and Veneer
12.Modular furniture
13.Loose furniture, sofa, side table
14.Chairs

B. Electrical works

1Panels and distribution boards

2.lt cables, cable trays, floor trunking

3.Earthing

4.point wiring

5.lighting fixtures

6.fire detection and alarm system

7.public addressal system

8.access control system

9.cctv surveillance system

10. rodent repellent system

11.fire fighting system

12.novac only from server room

13.wld for server room

C. HVAC works

1	Chiller
2	Pumps
3	Chilled Water Piping With Insulation
4	Condenser Water Piping With Insulation
5	Chilled Water Piping With Insulation
6	Air Handling Units (Smart AHUs)
7	Sheet Metal Works
8	Thermal & Acoustic Insulation
9	Ventilation Work
10	VRF ODU / IDU and Other Accessories
11	Refrigerant Piping
12	Frame Work
13	Air-Cooled Hi-Wall Split Units
14	Indigenous Work

D. IT works

1.IO Outlets

2.Module Face Plates

3. Patch Cord

4.Patch Panel

5.Server Rack

6.Optical Fiber Cable

7. Fiber Transceiver

(A) Contact Information

E-Procurement Technologies Ltd.	State Bank of India
B-704, Wall Street - II, Opp. Orient Club, Nr. Gujarat College, Ahmedabad - 380 006. Gujarat State, India Tel.: +91 79 61200 579 | 580 | 567 | 569 | 566 Mr.Samjad Khan E-mail : samjad@auctiontiger.net Contact No : 9879996111 /9265871720	1) The Deputy General Manager (Premises), State Bank of India, Corporate Centre, 9th Floor, State Bank Bhavan, Nariman Point, Mumbai-400 021 Officer Name: Mr. Rahul Parwate, Chief Manager (Civil) Department: Premises Contact No: 022 -22740906, 9717462906 E-mail: rahul.parvate@sbi.co.in; dgmpremises.cc@sbi.co.in

(B) SAMPLE BUSINESS RULE DOCUMENT

ONLINE E-TENDERING FOR PROPOSED INTERIOR WORKS AT 7TH TO 10TH FLOOR OF SBI BUILDING AT VASHI, NAVI MUMBAI

(A) Business rules for E-tendering:

1. Only contractors under appropriate category who are invited by the project Architect/SBI shall only be eligible to participate.

2. SBI will engage the services of an E-tendering service provider who will provide necessary training and assistance before commencement of online bidding on Internet.

3. In case of e-tendering, SBI will inform the vendor in writing, the details of service provider to enable them to contact and get trained.

4. Business rules like event date, closing and opening time etc. also will be communicated through service provider for compliance.

5. Contractors have to send by email, the compliance form in the prescribed format (provided by service provider), before start of E-tendering. Without this the vendor will not be eligible to participate in the event.

6. The Contractors will be required to submit the various documents in sealed Envelope to the office of SBI at the address mentioned hereinbefore by the stipulated date i.e. (1) Hard Copy of Technical Bid duly signed and stamped on each page (2) Demand Draft of specified amount of EMD. Contractors not submitting any one or more documents shall not be eligible to participate in the online price bidding.

7. E-tendering will be conducted on schedule date & time.

8. **The e-tendering will be treated as closed only when the bidding process gets closed in all respects for the item listed in the tender.**

(B) Terms & conditions of E-tendering:

SBI shall finalize the Tender through e-tendering mode for which M/s. E-Procurement Technologies Ltd. has been engaged by SBI an authorized service provider. Please go through the guidelines given below and submit your acceptance to the same along with your Commercial Bid.

1. E-tendering shall be conducted by SBI through M/s. E-Procurement Technologies Ltd., on prespecified date. While the Contractors shall be quoting from their own offices/ place of their choice, Internet connectivity and other paraphernalia requirements shall have to be ensured by Contractors themselves. In the event of failure of their Internet connectivity, (due to any reason whatsoever it may be) it is the bidders' responsibility. In order to ward-off such contingent situation bidders are requested to make all the necessary arrangements/ alternatives such as back–up power supply whatever required so that they are able to circumvent such situation and still be able to participate in the E-tendering successfully. Failure of power at the premises of Contractors during the E-tendering cannot be the cause for not participating in the E-tendering. On account of this the time for the E-tendering cannot be extended and SBI is not responsible for such eventualities.

2. M/s. E-Procurement Technologies Ltd.., shall arrange to train your nominated person(s), without any cost to you. They shall also explain you all the Rules related to the E-tendering. You are required to give your compliance on it before start of bid process.

3. BIDDING CURRENCY AND UNIT OF MEASUREMENT: Bidding will be conducted in Indian currency & Unit of Measurement will be displayed in Online E-tendering.

4. BID PRICE: The Bidder has to quote the rate as per the Tender Document provided by SBI their appointed Architects.

5. VALIDITY OF BIDS: The Bid price shall be firm for a period specified in the tender document and shall not be subjected to any change whatsoever.

6. Procedure of E-tendering:

   i. **Online E-tendering:**

   (a) The NIT &Technical bid available on the Bank's website during the period specified in the NIT.
   (b) Online e-tendering is open to all the bidders who receive NIT from the Architect and qualified for participating in the price bidding as provisions mentioned herein above through SBI approved Service Provider.
   (c) The Price-Bid shall be made available online by the Service Provider wherein the contractors will be required to fill-in their percentage rates on overall estimate.
   (d) The Contractors are advised not to wait till the last minute to submit their online tender price bid to avoid complications related with internet connectivity, network problems, system crash down, power failure, etc.
   (e) In case, contractor fails to quote their rates for any one or more tender items, their tender shall be treated as ***"Incomplete Tender***" and shall be liable for rejection.

7. LOG IN NAME & PASSWORD: Each Bidder is assigned a Unique User Name & Password by M/s. E-Procurement Technologies Ltd. The Bidders are requested to change the Password after the receipt of initial Password from M/s. E-Procurement Technologies Ltd. All bids made from the Login ID given to the bidder will be deemed to have been made by the bidder.

8. BIDS PLACED BY BIDDER: Bids will be taken as an offer to execute the work as specified. Bids once made, cannot be cancelled / withdrawn and the Bidder shall be bound to execute the work at the quoted bid price. In case the L-1 Bidder backs out or fail to complete the work as per the rates quoted, SBI shall at liberty to take action as deemed necessary including de-paneling such contractors and forfeiting their EMD.

9. At the end of the E-tendering, SBI will decide upon the winner. SBI decision on award of Contract shall be final and binding on all the Bidders.

10. SBI shall be at liberty to cancel the E-tendering process / tender at any time, before ordering, without assigning any reason.

11. SBI shall not have any liability to bidders for any interruption or delay in access to the site irrespective of the cause.

12. Other terms and conditions shall be as per your techno-commercial offers and other correspondences till date.

13. Note: Firm should possess valid digital signature for this e-tender.

1. OTHER TERMS & CONDITIONS:

- The Bidder shall not involve himself or any of his representatives in Price manipulation of any kind directly or indirectly by communicating with other suppliers / bidders.

- The Bidder shall not divulge either his Bids or any other exclusive details of SBI to any other party.

- SBI decision on award of Contract shall be final and binding on all the Bidders.

- SBI reserve their rights to extend, reschedule or cancel any E-tendering within its sole discretion.

- SBI or its authorized service provider M/s. E-Procurement Technologies Ltd. shall not have any liability to Bidders for any interruption or delay in access to the site irrespective of the cause.

- SBI or its authorized service provider/s. E-Procurement Technologies Ltd. is not responsible for any damages, including damages that result from, but are not limited to negligence.

- SBI or its authorized service M/s. E-Procurement Technologies Ltd. will not be held responsible for consequential damages, including but not limited to systems problems, inability to use the system, loss of electronic information etc. N.B.
- All the Bidders are required to submit the Process Compliance Statement (Annexure II) duly signed to M/s. E-Procurement Technologies Ltd.

- **All the bidders are requested to ensure that they have a valid digital signature certificate well in advance to participate in the online even**

(E) Price Confirmation Letter (Annexure III)

(The bidders are required to print this on their company's letter head and sign, stamp before emailing)

To,
E-Procurement Technologies Ltd. (Auction Tiger)
B-704, Wall Street - II,
Opp. Orient Club,
Nr. Gujarat College, Ahmedabad - 380 006.
Gujarat State, India

Sub: Final Price Quoted for Proposed Interior Works at 7th to 10th Floors of SBI building at Vashi, Navi Mumbai

Dear Sir,

We confirm that we have quoted.

Thanking you and looking forward to the valuable order from SBI.

Yours sincerely,

For _____

Name:
Company:
Date:
Seal:
Scan it and send to this Document on allocation@eptl.in

GENERAL CONDITIONS OF CONTRACT

1.0 **Definitions**: - "Contract means the documents forming the tender and the acceptance there of and the formal agreement executed between State Bank of India (client) and the contractor, together with the documents referred there in including these conditions, the specifications, designs, drawings and instructions issued from time to time by the architects/ Bank and all these documents taken together shall be deemed to form one contract and shall be complementary to one another.

1.1 In the contract the following expressions shall, unless the context otherwise requires, have the meaning hereby respectively assigned to them.

1.1.1 'SBl' shall mean State Bank of India (client) a body Corporate created under State Bank of India Act 1955, having its Corporate Centre at State Bank Bhavan, Madame Cama Road, Mumbai 400 021 and includes the client's representatives, successors and assigns.

Architects/ Consultants' shall mean M/s Architect Narayan and Associates Pvt. Ltd., Mumbai.

1.1.2 'Site Engineer' shall mean an Engineer appointed by the Bank at site as their representative for day-to-day supervision of work and to give instructions to the contractors.

1.1.3 'The Contractor' shall mean the individual or firm or company whether incorporate not, undertaking the works and shall include legal personal representative of individual or the composing the firm or company and the permitted assignees of individual or firms of company.

The expression 'works' or 'work' shall mean the permanent or temporary work description in the "Scope of work" and / or to be executed in accordance with the contract includes materials, apparatus, equipment, temporary supports, fittings and things of kinds to be provided, the obligations of the contractor hereunder and work to be done by the contractor under the contract.

1.1.4 'Engineer' shall mean the representative of the Architect / consultant.

1.1.5 'Drawings' shall mean the drawings prepared by the Architects and issued by the Engineer and referred to in the specifications and any modifications of such drawings as may be issued by the Engineer from time to time 'Contract value shall mean value of the entire work as stipulated in the letter of acceptance of tender subject such additions there to or deductions there from as may be made under the provide herein after contained.

1.1.6 'Specifications' shall mean the specifications referred to in the tender and any modifications thereof as may time to time be furnished or approved by the architect/ consultant "Month" means calendar month.

1.1.7 "Week" means seven consecutive days.

1.1.8 "Day" means a calendar day beginning and ending at 00 Hrs and 24 Hrs respectively.

CLAUSE

1.0 **Total Security Deposit**

Total Security deposit comprise of:

a) Earnest Money Deposit

b) Initial Security Deposit
c) Retention Money
d) Additional Security Deposit

a) **Earnest Money Deposit -**

The tenderer shall furnish EMD in the form of Demand drawn in favour of Assistant General Manager (Premises & Estate) SBI, LHO Mumbai, payable at Mumbai on any Scheduled Bank. No tender shall be considered unless the EMD is so deposited in the required form. No interest shall be paid on this EMD. The EMD of the unsuccessful tenderer shall be refunded soon after the decision to award the contract is taken without interest. The EMD shall stand absolutely forfeited if the tenderer revokes his tender at any time during the period when he is required to keep his tender open acceptance by the SBI or after it is accepted by the SBI the contractor falls to enter into a formal agreement or fails to pay the initial security deposit as stipulated or fails to commence the work within the stipulated time.

b) **Initial Security Deposit (lSD)**

The amount of ISD shall be 2% of accepted value of tender including the EMD. Balance of ISD (i.e. excluding EMD) is to be submitted in the form of D/D drawn on any scheduled Bank and shall be deposited within 15 days from the date of letter of acceptance of tender.

c) **Retention Money: -**

Besides the ISD as deposited by the contractor in the above said manner the retention money shall be deducted from the running account bill at the rate of 10% of the gross value of work done by the contractor and claimed in each bill provided the total security deposit i.e. the ISD plus Retention Money shall both together not exceed 5% of the contract value. 50% of the total security deposit shall be refunded to the contractor without any interest on issue of Virtual Completion certificate by the Architect/consultant. The balance 50% of the total security deposit shall be refunded to the contractors without interest within fifteen days after the end of defects liability period provided the contractor has satisfactorily attended to all defects in accordance with the conditions of contract including site clearance.

d) **Additional Security Deposit: -**

Additional Security deposit (ASD)/Additional performance Guarantee (APG) shall be applicable if the bid price is below 10 % of the estimated cost put to tender. The amount of such ASD/ APG shall be the difference between 90 % of estimated cost put to tender and the quoted price.

No interest shall be paid to the amount retained by the Bank as Security Deposit.

3.0 **Language Errors, omissions and discrepancies**

In case of errors, omissions and/ or disagreement between written and scaled dimensions on the drawings or between the drawings and specifications etc., the following order shall apply.

i) Between scaled and written dimension (or description) on a drawing, the latter shall be adopted.

ii) Between the written or shown description or dimensions in the drawings and the corresponding one in the specification the former shall be taken as correct.

iii) Between written description of the item in the specifications and descriptions in bills of quantities of the same item, the former shall be adopted:

iv) In case of difference between rates written in figures and words, the rate in words shall prevail.

v) Between the duplicate / subsequent copies of the tender, the original tender shall be taken as correct.

4.0 **Scope of Work:**

The contractor shall carry out, complete and maintain the said work in every respect strictly in accordance with this contract and with the directions of and to the satisfaction of the Bank to be communicated through the architect/consultant. The architect/consultant at the directions of the Bank from time to time issue further drawings and/or written instructions, details directions and explanations which are hereafter collectively referred to as Architect's/Consultant's instructions in regard to : the variation or modification of the design, quality or quantity of work or the addition or omission or substitution of any work, any discrepancy in the drawings or between the BOQ and/or drawings and/or specifications, the removal from the site of any material brought thereon by the contractor and the substitution of any other materials thereof, the demolition, removal and/or re-execution of any work executed by him, the dismissal from the work of any person employed/engaged thereupon.

5. (i) **Letter of Acceptance:**

Within the validity period of the tender the Bank shall issue a letter of acceptance either directly or through the architect by registered post or otherwise depositing at the address of the contractor as given in the tender to enter into a Contract for the execution of the work as per the terms of the tender. The letter of acceptance shall constitute a binding contract between the SBI and the contractor.

5.(ii) **Contract Agreement:**

On receipt of intimation of the acceptance of tender from the SBI/Architect the successful tenderer shall be bound to implement the contract and within **fifteen days** thereof he shall sign an agreement in a non-judicial stamp paper of appropriate value.

6.0 **Ownership of drawings**:

All drawings, specifications and copies thereof furnished by the SBI through its architect/ consultants are the properties of the SBI. They are not to be used on other work.

7.0 **Detailed drawings and instructions:**

The SBI through its architects/consultants shall furnish with reasonable promptness additional instructions by means of drawings or otherwise necessary for the proper execution of the work. All such drawings and instructions shall be consistent with the contract documents, true developments thereof and reasonably inferable there from.

The work shall be executed in conformity therewith and the contractor prepare a detailed programme schedule indicating therein the date of start and completion of various activities on receipt of the work order and submit the same to the SBI through the Architect/Consultant.

Copies of agreement
Two copies of agreement duly signed by both the parties with the drawings shall be handed over to the contractors.

8.0 **Liquidated damages:**

If the contractor fails to maintain the required progress in terms of the relevant clause of GCC or to complete the work and clear the site including vacating their office on or before the contracted or extended date or completion without justification in support of the cause of delay, he may be called upon without prejudice to any other right of remedy available under the law to the SBI on account of such breach to pay a liquidated damages at the rate of 0.5% of the contract value per week subject to a maximum of 5% of the contract value.

9.0 **Materials, Appliances and Employees**

Unless or otherwise specified the contractor shall provide and pay for all materials, labour, water, power, tools, equipment transportation and any other facilities that are required for the satisfactory execution and completion of the work. Unless or otherwise specified all materials shall be new and both workmanship and materials shall be best quality. The contractor shall at all times enforce strict discipline and good order among his employees and shall not employ on the work any unfit person or anyone not skilled in the work assigned to him. Workman whose work or behaviour is found to be unsatisfactory by the SBI/Architect/Consultant he shall be removed from the site immediately.

10.0 **Permits, Laws and Regulations:**

Permits and licences required for the execution of the work shall be obtained by the contractor at his own expenses.

The contractor shall give notices and comply with the regulations, laws, and ordinances rules, applicable to the contractor. If the contractor observes any discrepancy between the drawings and specifications, he shall promptly notify the SBI in writing under intimation of the Architect/Consultant. If the contractor performs any act which is against the law, rules and regulations he shall meet all the costs arising there from and shall indemnify the SBI any legal actions arising there from..

11.0 **Setting out Work:**

The contractor shall set out the work and shall be responsible for the true and perfect setting out of the same and for the correctness of the positions, levels, dimensions, and alignment of all parts thereof and get it approved by the architect/consultant before proceeding with the work. If at any time any error in this respect shall appear during the progress of the works, irrespective of the fact that the layout had been approved by the architect/consultant the contractor shall be responsible for the same and shall at his own expenses rectify such error, if so, required to satisfaction of the SBI.

12.0 **Protection of works and property:**

The contractor shall continuously maintain adequate protection, of all his work from damage and shall protect the SBI's properties from injury or loss arising in connection with contract. He shall make good any such damage, injury, loss due to his fault or negligence except which are due to causes beyond his control.
He shall take adequate care and steps for protection of the adjacent properties. The contractor shall take all precautions for safety and protection of his employees on the works and shall comply with all applicable provisions of Government and local bodies' safety laws and building codes to prevent accidents, or injuries to persons or property of about or adjacent to his place of work. The contractor shall take insurance covers as per the relevant clause at his own cost. The policy may be taken in joint names of the contractors and the SBI and the original policy may be lodged with the SBI.

13.0 **Inspection of work:**

The SBI/Architect/Consultant or their representatives shall at all reasonable time have free access to the work site and/or to the workshop, factories or other places where materials are lying or from where they are obtained and the contractor shall give every facility to the SBI, Architect/Consultant and their representatives necessary for inspection and examination and test of the materials and workmanship. No person unless authorized by the SBI/Architect/Consultant except the representative of Public authorities shall be allowed on the work at any time. The proposed work either during its construction stage or its completion can also be inspected by the Chief Technical Examiner's organization a wing of Central Vigilance Commission.

14.0 **Assignment and subletting**

The whole of work included in the contract shall be executed by the contractor and he shall not directly entrust and engage or indirectly transfer assign or underlet the contract or any part or share thereof or interest therein without the written consent of the SBI through the architect and no undertaken shall relieve the contractor from the responsibility of the contractor from active superintendence of the work during its progress.

15.0 **Quality of materials, workmanship & Test**

(i) All materials and workmanship shall be best of the respective kinds described in the contract and in accordance with Architect/Consultant instructions and shall be subject from time to time to such tests as the architect/consultant may direct at the place of manufacture or fabrication or on the site or an approved testing laboratory. The contractor shall provide such assistance, instruments, machinery, labour and materials

ii) Samples

All samples of adequate numbers, size, shades & pattern as per specifications shall be supplied by the contractor without any extra charges. If certain items proposed to be used are of such nature that samples cannot be presented or prepared at the site detailed literature/test certificate of the same shall be provided to the satisfaction of the Architect/ consultant. Before submitting the sample/literature the contractor shall satisfy himself that the material/equipment for which he is submitting the samples/literature meet with the requirement of tender specification. Only when the samples are approved in writing by the architect/consultant the contractor shall proceed with the procurement and installation of the particular material/equipment. The approved samples shall be signed by the Architect/Consultant for identification and shall be kept on record at site office until the completion of the work for inspection/comparison at any time. The Architect/Consultant shall take reasonable time to approve the sample. Any delay that might occur in approving the samples for reasons of its not meeting the specifications or other discrepancies inadequacy in furnishing samples of best qualities from various manufacturers and such other aspects causing delay on the approval of the materials / equipment etc shall be to the account of the contractor.

iii) **Cost of tests**

The cost of making any test shall be borne by the contractor if such test is intended by or provided for in the specification or BOQ.

iv) **Costs of tests not provided for**
If any test is ordered by the Architect/ Consultant which is either:

If so intended by or provided for or (in the cases above mentioned) is not so particularized or through so intended or provided for but ordered by the Architect/Consultant which is either to be carried out

by an independent person at any place other than the site or the place of manufacture or fabrication of the materials tested or any Government/approved laboratory, then the cost of such test shall be borne by the contractor.

16.0 **Obtaining information related to execution of work**

No claim by the contractor for additional payment shall be entertained which is consequent upon failure on his part to obtain correct information as to any matter affecting the execution of the work nor any misunderstanding or the obtaining incorrect information or the failure to obtain correct information relieve him from any risks or from the entire responsibility for the fulfilment of contract.

17.0 **Contractor's superintendence**

The contractor shall give necessary personal superintendence during the execution of the works and as long, thereafter, as the Architect/consultant may consider necessary until the expiry of the defects liability period, stated hereto.

18.0 **Quantities**

i)The bill of quantities (BOQ) unless or otherwise stated shall be deemed to have been prepared in accordance with the Indian Standard Method of Measurements.

The rate quoted shall remain valid for variation of quantity against individual item to any extent subject to maximum variation of the contract value by 25%. The entire amount paid under the relevant Clause hereof as well as amounts of prime cost and provisional sums, if any, shall be excluded.

ii)Variation exceeding 25%: The items of work executed in relation to variation exceeding 25% shall be paid on the basis of provisions of the relevant clause hereof.

19.0 **Works to be measured**

The Architect/Consultant may from time to time intimate to the contractor that he required the work to be measured and the contractor shall forthwith attend or send a qualified representative to assist the Architect in taking such measurements and calculation and to furnish all particulars or to give all assistance required by any of them. Such measurements shall be taken in accordance with the Mode of measurements detailed in the specifications. The representative of the Architect/Consultant shall take joint measurements with the contractor's representative and the measurements shall be entered in the measurement book. The contractor or his authorized representative shall sign all the pages of the measurement book in which the measurements have been recorded in token of his acceptance. All the corrections shall be duly attested by both representatives. No over writings shall be made in the M book. Should the contractor not attend or neglect or omit to depute his representative to take measurements then the measurements recorded by the representative of the Architect/consultant shall be final. All authorized extra work, omissions and all variations made shall be included in such measurements.

20.0 **Variations**

No alteration, omission or variation ordered in writing by the Architect/Consultant shall vitiate the contract.
In case the SBI/Architect/Consultant thinks proper at any time during the progress of works to make any alteration in, or additions to or omission from the works or any alteration in the kind or quality of the materials to be used therein, the Architect/Consultant shall give notice thereof in writing to the contractor or shall confirm in writing within seven days of giving such oral instructions the contractor shall alter to, add to, or omit from as the case may be in accordance with such notice but the

contractor shall not do any work extra to or make any alteration or additions to or omissions from the works or any deviation from any of the provisions of the contract, stipulations, specifications or contract drawings without previous consent in writing of the Architect/Consultant and the value of such extras, alterations, additions or omissions shall in all cases be determined by the Architect/Consultant and the same shall be added to or deducted from the contract value, as the case may be.

21.0 **Valuation of Variations**

No claim for an extra shall be allowed unless it shall have been executed under the authority of the Architect/Consultant with the concurrence of the SBI as herein mentioned. Any such extra is herein referred to as authorized extra and shall be made in accordance with the following provisions.

a) The net rates or prices in the contract shall determine the valuation of the extra work where such extra work is of similar character and executed under similar conditions as the work priced herein. Rates for all items, wherever possible should be derived out of the rates given in the priced BOQ

b) The net prices of the original tender shall determine the value of the items omitted, provided if omissions do not vary the conditions under which any remaining items of works are carried out, otherwise the prices for the same shall be valued under sub relevant clause hereunder.

c) Where the extra works are not of similar character and/or executed under similar conditions as aforesaid or where the omissions vary the conditions under which any remaining items or works are carried out, then the contractor shall within 7 days of the receipt of the letter of acceptance inform the Architect/Consultant of the rate which he intends to charge for such items of work, duly supported by analysis of the rate or rates claimed and the Architect/Consultant shall fix such rate or prices as in the circumstances in his opinion are reasonable and proper, based on the market rate.

d) Where extra work cannot be properly measured or valued the contractor shall be allowed day work prices at the net rates stated in the tender of the BOQ or, if not, so stated then in accordance with the local day work rates and wages for the district; provided that in either case, vouchers specifying the daily time (and if required by the Architect/Consultant) the workman's name and materials employed be delivered for verifications to the Architect/Consultant at or before the end of the week following that in which the work has been executed.

e) It is further clarified that for all such authorized extra items where rates cannot be derived from the tender, the contractor shall submit rates duly supported by rate analysis worked on the "market rate basis" for material, labour, hire/running charges of equipment and wastages etc plus 15% towards establishment charges, contractor's overheads and profit. Such items shall not be eligible for escalation.

22.0 **Final measurement**

The measurement and valuation in respect of the contract shall be completed within six months of the virtual completion of the work.

23.0 **Virtual Completion Certificate (VCC)**

On successful completion of entire works covered by the contract to the full satisfaction of the SBI, the contractor shall ensure that the following works have been completed the satisfaction of the SBI:

a) Clear the site of all scaffolding, wiring, pipes, surplus materials, contractor's labour equipment and machinery.

b) Demolish, dismantle and remove the contractor's site office, temporary works, structure including labour sheds/camps and constructions and other items and things whatsoever brought upon or erected at the site or any land allotted to the contractor by the SBI not incorporated in the permanent works.

c) Remove all rubbish, debris etc. from the site and the land allotted to the contractor the SBI and shall clear, level and dress, compact the site as required by the SBI.

d) Shall put the SBI in undisputed custody and possession of the site and all land allot by the SBI.

e) Shall hand over the work in a peaceful manner to the SBI.

f) All defects / imperfections have been attended and rectified as pointed out by the Architects to the full satisfaction of SBI.

Upon the satisfactory fulfilment by the contractor as stated above, the contractor shall be entitled to apply to the Architect/Consultant for the certificate. If the Architect/Consultant is satisfied of the completion of the work, relative to which the completion certificate has been sought, the Architect/Consultant shall within fourteen (14) days of the receipt of the application for virtual completion certificate, issue a VCC in respect of the work for which the VCC has been applied.

This issuance of a VCC shall be without prejudice to the SBI's rights and contractor's liabilities under the contract including the contractor's liability for defects liability period nor shall the issuance of VCC in respect of the works or work at any site be construed as a waiver of any right or claim of the SBI against the contractor in respect of works or work at the site and in respect of which the VCC has been issued.

24.0 **Work by other agencies**

The SBI/Architect/Consultant reserves the rights to use premises and any portion of the site for execution of any work not included in the scope of this contract which it may desire to have carried out by other persons simultaneously and the contractor shall not only allow but also extend reasonable facilities for the execution of such work. The contractor however shall not be required to provide any plant or material for the execution of such work except by special arrangement with the SBI. Such work shall be carried out in such manners not to impede the progress of the works included in the contract.

25.0 **Insurance of works**

25.1 Without limiting his obligations and responsibilities under the contract the contractor shall insure in the joint names of the SBI and the contractor against all loss or damages from whatever cause arising other than the excepted risks, for which he is responsible under the terms of contract and in such a manner that the SBI and contractor are covered for the period stipulated in the relevant clause of GCC and are also covered during the period of maintenance for loss or damage arising from a cause, occurring prior to the commencement of the period of maintenance and for any loss or damage occasioned by the contractor in the course of any operations carried out by him for the purpose of complying with his obligations under relevant clause.

a) The Works for the time being executed to the estimated current Contract value thereof, or such additional sum as may be specified together with the materials for incorporation in the works at their replacement value.

b) The constructional plant and other things brought on to the site by the contractor to the replacement value of such constructional plant and other things.

c) Such insurance shall be effected with an insurer and in terms approved by the SBI which approval shall not be unreasonably withheld and the contractor shall whenever required produce to the Architect / consultant the policy if insurance and the receipts for payment of the current premiums.

25.2 **Damage to persons and property**

The contractor shall, except if and so far as the contract provides otherwise indemnify the SBI against all losses and claims in respect of injuries or damages to any person or material or physical damage to any property whatsoever which may arise out of or in consequence of the execution and maintenance of the works and against all claims proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto except any compensation of damages for or with respect to :

a) The permanent use or occupation of land by or any part thereof.

b) The right of SBI to execute the works or any part thereof on, over, under, in or through any lands.

c) Injuries or damages to persons or properties which are unavoidable result of the execution or maintenance of the works in accordance with the contract

d) Injuries or damage to persons or property resulting from any act or neglect of the SBI their agents, employees or other contractors not being employed by the contractor or for or in respect of any claims, proceedings, damages, costs, charges and expenses in respect thereof or in relation thereto or where the injury or damage was contributed to by the contractor, his servants or agents such part of the compensation as may be just and equitable having regard to the extent of the responsibility of the SBI, their employees, or agents or other employees, or agents or other contractors for the damage or injury.

25.3 **Contractor to indemnify SBI**

The contractor shall indemnify the SBI against all claims, proceedings, damages, costs, charges and expenses in respect of the matters referred to in the provision of the relevant clause.

25.4 **Contractor's superintendence**

The contractor shall fully indemnify and keep indemnified the SBI against any action, claim, or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties which may be payable in respect of any article or part thereof included in the contract. In the event of any claim made under or action brought against SBI in respect of such matters as aforesaid the contractor shall be immediately notified thereof and the contractor shall be at liberty, at his own expenses to settle any dispute or to conduct any litigation that may arise there from, provided that the contractor shall not be liable to indemnify the SBI if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Architect/Consultant in this behalf.

25.5 **Third Party Insurance**

25.5.1 The contractors under the terms of the contract are required to keep the works duly insured under CAR Policy (Contractor All Risk Policy) as well as third Party Insurance for minimum value of Rs. 20 Lakhs until the Completion of the project or handing over whichever is later. The Bank shall ensure that proper insurance policies are taken in the joint names by the contractors and the same are renewed at appropriate time. The policies taken out by the contractor shall be kept in safe custody of the concerned Department of the Bank. The Site Engineer/PMC shall ensure that insurance policies

are in order while certifying the contractor's bills. The concerned Department of the Bank shall also verify at the time of releasing payments to the contractors.

Before commencing the execution of the work the contractor but without limiting his obligations and responsibilities under the relevant of GCC shall insure against his liability for any material or physical damage, loss, or injury which may occur to any property including that of SBI, or to any person, including any employee of the SBI, by or arising out of the execution of the works or in the carrying out of the contract, otherwise than due to the matters referred to in the provision to the said clause thereof.

25.5.2 **Minimum amount of Third Party Insurance**

Such insurance shall be affected with an insurer and in terms approved by the SBI which approval shall not be reasonably withheld and for at least the amount stated below. The contractor shall, whenever required, produce to the Architect/Consultant the policy or policies of insurance cover and receipts for payment of the current premiums.

25.6 The minimum insurance cover for physical property, injury, and death is Rs. 20.00 lacs per occurrence with the number of occurrences limited to four. After each occurrence contractor will pay additional premium necessary to make insurance valid for four occurrences always.

25.7 **Accident or Injury to workman:**

25.7.1 The SBI shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workmen or other person in the employment of the contractor or any sub-contractor, save and except an accident or injury resulting from any act or default of the SBI or their agents, or employees. The contractor shall indemnify and keep indemnified SBI against all such damages and compensation, save and except as aforesaid and against all claims, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

25.7.2 **Insurance against accidents etc. to workmen**

The contractor shall insure against such liability with an insurer approved by the SBI during the whole of the time any person employed by him on the works and shall, when required, produce to the architect/consultant such policy of insurance and receipt for payment of the current premium.
Provided always that, in respect of any persons employed by any sub-contractor the contractor's obligation to insure as aforesaid under this sub-clause shall be satisfied if the sub contractor shall have insured against the liability in respect of such persons in such manner that SBI is indemnified under the policy but the contractor shall require such sub-contractor to produce to the Architect/Consultant when required such policy of insurance and the receipt for the payment of the current premium.

25.7.3 **Remedy on contractor's failure to insure**
If the contractor fails to effect and keep in force the insurance referred to above or any other insurance which he may be required to effect under the terms of contract, then and in any such case the SBI may effect and keep in force any such insurance and pay such premium or premiums as may be necessary for that purpose and from time to time deduct the amount so paid by the SBI as aforesaid and also deduct 15% of contract value from any amount due or which may become due to the contractor, or recover the same as debt from the contractor.

25.7.4 Without prejudice to the other rights of the SBI against contractors in respect of such default, the Bank shall be entitled to deduct from any sums payable to the contractor the amount of any damages costs, charges, and other expenses paid by the SBI and which are payable by the contractors under this clause. The contractor shall upon settlement by the insurer of any claim made against the insurer pursuant to a policy taken under this clause, proceed with due diligence to rebuild or repair the works

destroyed or damaged. In this event all the monies received from the insurer in respect of such damage shall be paid to the contractor and the contractor shall not be entitled to any further payment in respect of the expenditure incurred for rebuilding or repairing of the materials or goods destroyed or damaged.

26.0 **Commencement of Works:**

The date of commencement of the work will be reckoned as the recorded date of handing over site by the SBI or 15 days from the date of issue of Letter of Acceptance of Bank, whichever is later.

27.0 **Time for completion**

Time is essence of the contract and shall be strictly observed by the contractor. The entire work shall be completed within a period of **03 months (Including monsoon and public holidays)** from the date of commencement. If required in the contract or as directed by the Architect / consultant. The contractor shall complete certain portions of work before completion of the entire work. However, the completion date shall be reckoned as the date by which the whole work is completed as per the terms of the contract.

28.0 **Extension of time**

If, in the opinion of the Architect/Consultant, the work be delayed for reasons beyond the control of the contractor, the Architect/Consultant may submit a recommendation to the SBI to grant a fair and reasonable extension of time for completion of work as per the terms of contract. If the contractor needs an extension of time for the completion of work or if the completion of work is likely to be delayed for any reasons beyond the due date of completion as stipulated in the contract, the contractor shall apply to the SBI through the Architect/Consultant in writing at least 30 days before the expiry of the scheduled time and while applying for extension of time he shall furnish the reasons in detail and his justification if any, for the delays. The architect/consultant shall submit their recommendations to the SBI in the prescribed format for granting extension of time. While granting extension of time the contractor shall be informed the period extended time which will qualify for levy of liquidated damages. For the balance period in excess of original stipulated period and duly sanctioned extension of time by the SBI the provision of liquidated damages as stated under the relevant clause of GCC shall become applicable. Further contract shall remain in force even for the period beyond the due date of completion irrespective whether the extension is granted or not.

29.0 **Rate of progress**

Whole of the materials, plant and labour to be provided by the contractor and the mode, manner and speed of execution and maintenance of the works are to be of a kind and conducted in a manner to the satisfaction of the Architect/Consultant. Should the rate of progress of the work or any part

thereof be at any time be in the opinion of the Architect/ Consultant too slow to ensure the completion of the whole of the work by the prescribed time or extended time for completion the Architect/Consultant shall thereupon take such steps as considered necessary by the Architect/Consultant to expedite progress so as to complete the woks by the prescribed time or extended time. Such communications from the Architect/Consultant neither shall the relieve the contractor from fulfilling obligations under the contract nor he shall be entitled to raise any claims arising out of such directions.

30.0 **Work during nights and holidays**

Subject to any provision to the contrary contained in the contract no permanent work shall save as herein provided be carried on during the night or on holidays without the permission in writing of the Architect/Consultant, save when the work is unavoidable or absolutely necessary for the saving

of life or property or for the safety of the work in which case the contractor shall immediately advise the Architect/Consultant. However, the provision of the clause shall not be applicable in the case of any work which becomes essential to carry by rotation or double shifts in order to achieve the progress and quality of the part of the works being technically required and continued with the prior approval of the Architect/consultant at no extra cost to the SBI.

All work at night after obtaining approval from competent authorities shall be carried out without unreasonable noise and disturbance.

31.0 **No compensation or restrictions of work**

If at any time after acceptance of the tender SBI shall decide to abandon or reduce the scope of work for any reason whatsoever and hence not required the whole or any part of the work to be carried out. The Architect / consultant shall give notice in writing to that effect to the contractor and the contractor shall act accordingly in the matter. The contractor shall have no claim to any payment of compensation or otherwise what so ever on account of any profit or advantage which he might have derived from the execution of the Work fully but which he did not derive in consequence of the foreclosure of the whole or part of the work.

Provided that the contractor shall be paid the charges on the cartage only of materials actually and bona fide brought to the site of the work by the contractor and rendered surplus as a result of the abandonment, curtailment of the work or any portion thereof and then taken back by the contractor, provided however that the Architect/Consultant shall have in such cases the option of taking over all or any such materials at their purchase price or a local current rate whichever is less.

In case of such stores having been issued from SBI stores and returned by the contractor to stores, credit shall be given to him at the rates not exceeding those at which were originally issued to the contractor after taking into consideration and deduction for claims on account of any deterioration or damage while in the custody of the contractor and in this respect the decision of Architect/Consultant shall be final.

32.0 Suspension of work

The contractor shall, on receipt of the order in writing of the Architect / consultant (whose decision shall be final and binding on the contractor) suspend the progress of works or any part thereof for such time and in such manner as Architect /consultant may consider necessary so as not to cause any damage or injury to the work already done or endanger the safety thereof for any of following reasons:

a) On account any default on the part of the contractor, or
b) For proper execution of the works or part thereof for reasons other than the default the contractor, or
c) For safety of the works or part thereof.

The contractor shall, during such suspension, properly protect and secure the works the extent necessary and carry out the instructions given in that behalf by the Architect / consultant.

If the suspension is ordered for reasons (b) and (c) in sub-para (i) above:
The contractor shall be entitled to an extension of time equal to the period of every such suspension. No compensation whatsoever shall be paid on this account.

33 **Action when the whole security deposit is forfeited**

In any case in which under any clause or clauses of this contract, the Contractor shall have rendered himself liable to pay compensation amounting to the whole of his security deposit the Architect/Consultant shall have the power to adopt any of the following course as they may deem best suited to the interest of the SBI:

a) To rescind the contract (of which rescission notice in writing to the contractor by - Architect / consultant shall be conclusive evidence) and in which case the security deposit of the contractor shall be forfeited and be absolutely at the disposal of SBI.

b) To employ labour paid by the SBl and to supply materials to carry out the work, or part of the work, debiting the contractor with the cost of the labour and materials cost of such labour and materials as worked out by the Architect/consultant shall final and conclusive against the contractor) and crediting him with the value of the work done, in all respects in the same manner and at the same manner and at the same rates as if it had been carried out by the contractor under the terms of this contract certificate of architect /consultant as to the value of work done shall be final conclusive against the contractor.

c) To measure up the work of the contractor, and to take such part thereof as shall be unexecuted, out of his hands, and to give it to another contractor to complete in which case any expenses which may be incurred in excess of the sum which would have been paid to the original contractor, if the whole work had been executed by him (The amount of which excess the certificates in writing of the Architects / consultant shall final and conclusive) shall be borne by original contractor and may be deducted f any money due to him by SBI under the contract or otherwise, or from his security deposit or the proceeds of sale thereof, or sufficient part thereof.

In the event of any of above courses being adopted by the SBI the contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased or procured any material or entered into any engagements or make any advances on account of, or with a view to the execution of the work or the performance of the contract and in case the contract shall be rescinded under the provision aforesaid, the contractor shall not be entitled to recover or to be paid any sum or any work thereto for actually performed under this contract, unless, and until the Architect/Consultant will have certified in writing the performance of such work and the value payable in respect thereof, and he shall only be entitled to be paid the value so certified.

34.0 **Owner's right to terminate the contract**

If the contractor being an individual or a firm commit any 'Act of Insolvency' or shall be adjudged an insolvent or being an incorporated company shall have an order for compulsory winding up voluntarily or subject to the supervision of Government and of the Official Assignee of the liquidator in such acts of insolvency or winding up shall be called upon within seven days after notice to him to do so, to show to the reasonable satisfaction of the Architect/Consultant that he is able to carry out and fulfil the contract, and provide security therefore if so required by the Architect/Consultant.

Or if the contractor (whether an individual firm or incorporated Company) shall suffer execution to be issued or shall suffer any payment under this contract to be attached by or on behalf of any of the creditors of the contractor.

Or shall assign or sublet this contract without the consent in writing of the SBI through the Architect/Consultant or shall charge or encumber this contract or any payment due to which may become due to the contractor there under:

a) Has abandoned the contract; or

b) Has failed to commence the works, or has without any lawful excuse under these conditions suspended the progress of the works for 14 days after receiving from the SBI through the Architect / consultant written notice to proceed.

c) Has failed to proceed with the works with such diligence and failed to make such due progress as would enable the works to be completed within the time agreed upon, or has failed to remove the materials from the site or to pull down and replace work within seven days after written notice from

the SBI through the Architect/ Consultant that the said materials were condemned and rejected by the Architect/ Consultant under these conditions; or has neglected or failed persistently to observe and perform all or any of the acts, matters or things by this contract to be observed and performed by the contractor for seven days after written notice shall have been given to the contractor to observe or perform the same or has to the detriment of good workmanship or in defiance of the SBI's or Architect's/Consultant's instructions to the contrary subject any part of the contract. Then and in any of said cases the SBI and or the Architect/Consultant, may not withstanding any previous waiver, after giving seven days' notice in writing to the contractor, determine the contract, but without thereby affecting the powers of the SBI or the Architect/Consultant or the obligation and liabilities of the contractor the whole of which shall continue in force as fully as if the contract had not been so determined and as if the works subsequently had been executed by or on behalf of the contractor. And, further the SBI through the Architect/Consultant, their agents or employees may enter upon and take possession of the work and all plants, tools, scaffoldings, materials, sheds, machineries lying upon the premises or on the adjoining lands or roads, use the same by means of their own employees or workmen in carrying on and completing the work or by engaging any other contractors or persons to complete the work and the contractor shall not in any interrupt or do any act, matter or thing to prevent or hinder such other contractor or other persons employed for completing and finishing or using the materials and plant for the works.

When the works shall be completed or as soon thereafter as convenient the SBI or the Architect/Consultant shall give a notice in writing to the contractor to remove his surplus materials and plants and should the contractor fail to do so within 14 days after receipt thereof by him the SBI sell the same by public auction after due publication and shall adjust the amount realized by such auction. The contractor shall have no right to question any of the act of the SBI incidental to the sale of the materials etc.

35.0 **Certificate of payment**

The contractor shall be entitled under the certificates to be issued by the Architect/ Consultant to the contractor within 10 working days from the date of certificate to the payment from SBI from time to time. The SBI shall recover the statutory recoveries and other dues including the retention amount from the certificate of payment.

Provided always that the issue of any certificate by the Architect/Consultant during the progress of works or completion shall not have effect as certificate of satisfaction or relieve the contractor from his liability under clause.

The Architect/Consultant shall have power to withhold the certificate if the work or any part thereof is not carried out to their satisfaction.

The Architect/Consultant may by any certificate make any corrections required in previous certificate.

The SBI shall modify the certificate of payment as issued by the Architect/Consultant from time to time while making the payment.

The contractor shall submit interim bills only after taking actual measurements and properly recorded in the Measurement book (M.B).

The Contractor shall not submit interim bills when the approximate value of work done by him is less than **30% of the total work** and the minimum interval between two such bills shall be one month.

The final bill may be submitted by contractor within a period of **one month** from the date of virtual completion and Architect/Consultant shall issue the certificate of payment within a period of two

months. The SBI shall pay the amount within a period of three months from the date of issue of certificate provided there is no dispute in respect of rates and quantities.

The contractor shall submit the interim bills in the prescribed format with all details.

36.0 **A. Settlement of Disputes and Arbitration**

Except where otherwise provided in the contract all questions and disputes relating to the meaning of the specifications, design, drawings and instructions herein before mentioned and as to the quality of workmanship or materials used on the work or as to any other question, claim, right, matter or thing whatsoever in any way arising out of or relating to the contract, designs, drawings, specifications, estimates, instructions, orders or these conditions or otherwise concerning the work or the execution or failure to execute the same, whether arising during the progress of the work or after the cancellation, termination, completion or abandonment thereof shall be dealt with as mentioned hereinafter:

i) If the contractor considers that he is entitled to any extra payment or compensation in respect of the works over and above the amounts admitted as payable by the Architect or in case the contractor wants to dispute the validity of any deductions or recoveries made or proposed to be made from the contract or raise any dispute, the Contractor shall forthwith give notice in writing of his claim, or dispute to the Assistant General Manager (Premises& Estate) endorse a copy of the same to the

Architect, within 30 days from the date of disallowance thereof or the date of deduction or recovery. The said notice shall give full particulars of the claim, grounds on which it is based and detailed calculations of the amount claimed and the contractor shall not be entitled to raise any claim nor shall the Bank be in any way liable in respect of any claim by the contractor unless notice of such claim shall have been given by the contractor to the Assistant General Manager (Premises& Estate in the manner and within the time as aforesaid. The contractor shall be deemed to have waived and extinguished all his rights in respect of any claim not notified to the Assistant General Manager (Premises & Estate) in writing in the manner and within the time aforesaid

ii) The Deputy General Manager (Premises) shall give his decision in writing on the claims notified by the contractor. The contractor may within 30 days of the receipt of the decision of the Deputy General Manager (Premises) submit his claims to the conciliating authority namely the General Manager (Ops) for conciliation along with all details and copies of correspondence exchanged between him and the Deputy General Manager (Premises).

iii) If the conciliation proceedings are terminated without settlement of the disputes, the contractor shall, within a period of 30 days of termination thereof shall give a notice to the concerned Officer of the Bank for appointment of an arbitrator to adjudicate the notified claims failing which the claims of the contractor shall be deemed to have been considered absolutely barred and waived.

iv) Except where the decision has become final, binding and conclusive in terms of the contract, all disputes or differences arising out of the notified claims of the contractor as aforesaid and all claims of the Bank shall be referred for adjudication through arbitration by the Sole Arbitrator appointed by the Chief General Manager at Global Markets, Corporate Centre. It will also be no objection to any such appointment that the Arbitrator so appointed is a technically competent person not below the rank of Superintending Engineer or equivalent position in Public Sector Banks / CPSEs, CPWD, LIC, RBI etc. If the arbitrator so appointed is unable or unwilling to act or resigns his appointment or vacates his office due to any reason whatsoever another sole arbitrator shall be appointed in the manner aforesaid by the Officer. Such person shall be entitled to proceed with the reference from the stage at which it was left by his predecessor.

v) It is a term of this contract that the party invoking arbitration shall give a list of disputes with amounts claimed in respect of each dispute along with the notice for appointment of arbitrator.

vi) It is also a term of this contract that no person other than a person appointed by such Chief General Manager aforesaid should act as arbitrator.

vii) The conciliation and arbitration shall be conducted in accordance with the provisions of the Arbitration & Conciliation Act 1996 or any statutory modification or re-enactment thereof and the rules made there under.

viii) It is also a term of the contract that if any fees are payable to the arbitrator these shall be paid equally by both the parties.

ix) It is also a term of the contract that the arbitrator shall be deemed to have entered on the reference on the date he issues notice to both the parties calling them to submit their statement of claims and counter statement of claims. The venue of the arbitration shall be such place as may be fixed by the arbitrator in his sole discretion. The fees if any, of the arbitrator shall, if required to be paid before the award is made and published, be paid half and half by each of the parties. The cost of the reference and of the award (including the fees, if any of the arbitrator) shall be in the discretion of the arbitrator who may direct to any by whom and in what manner, such costs or any part thereof shall be paid and fix or settle the amount of costs to be so paid.

37.0 **Power Supply**

The contractor shall make his own arrangements for power and supply/distribution system for driving plant or machinery for the work and for lighting purpose at his own cost. The cost of running and

maintenance of the plants are to be included in his tender prices. He shall pay all fees and charges required for the power supply and include the same in his tendered rates and hold the owner free from all such costs. He has to obtain necessary approval from the appropriate authorities, if required.

38.0 **Water supply**

The contractor shall make his own arrangements for water required for the work and nothing extra will be paid for the same. This will be subject to the following conditions:

i) That the water used by the contractor shall be fit for construction purposes to the satisfaction of the Architect / consultant's.

ii) The contractor shall make alternative arrangements for the supply of water if the arrangement made by the contractor for procurement of water in the opinion of the Architect / consultant is unsatisfactory.

38.1 The Contractor shall construct temporary well/tube well in SBI land for taking water for construction purposes only after obtaining permission in writing from the SBI. The contractor has to make his own arrangements for drawing and distributing the water at his own cost. He has to make necessary arrangements. To avoid any accidents or damages caused due to construction and subsequent maintenance of the wells. He has to obtain necessary approvals from the local authorities, if required.at his own cost. He shall restore the ground to its original condition after wells are dismantled on completion of work or hand over the well to the SBI without any compensation as directed by the Architect/Consultant.

39.0 **Treasure trove etc.**

Any treasure trove, coin or object antique which may be found on the site shall be the property of SBI and shall be handed over to the Bank immediately.

40.0 **Method of measurement**

Unless otherwise mentioned in the schedule of quantities or in mode of measurement, the measurement will be on the net quantities or work produced in accordance with up to date. Rules laid down by the Bureau of Indian Standards. In the event any dispute/disagreement the decision of the Architect/Consultant shall be final and binding on the contractor.

41.0 **Maintenance of registers**

The contractor shall maintain the following registers as per the enclosed perform at site of work and should produce the same for inspection of SBI architect / consultant whenever desired by them. The contractor shall also maintain the records / registers as required by the local authorities / Govt. from time to time.

1	Measurement Books.
2	Cement Register (Daily Record).
3	Steel Register.
4	Steel Consumption Register – Bill wise.
5	Drawings register
6	Materials at site register.
7	Register for hindrance to work
8	Concrete cube Test Register.
9	File and Register for extra / variation items.
10	Materials test Register and File.
11	Site Order Book (in triplicate).
12	Lead caulking Register.
13	Labour Reports and progress Reports Register.
14	Site Visit & Instructions Register.
15	Certified true copies of the contracts
16	Register for running account bill & Register for secured advance
17	Register for labour

42.0 PRICE VARIATION ADJUSTMENT (PVA) FOR ALL MATERIALS (INCLUDING CEMENT & STEEL) & LABOUR

(Applicable only for completion period beyond 12 months)

In partial modification of the provisions made elsewhere in this contract regarding rate quoted being not subject to any variations, price adjustments to the value of work payable to the Contractor at tendered rates shall be made towards variations in the prices of materials and labour in the manner specified hereunder: -

(a) There be any variation in the Consumer Price Index- General Index- for industrial workers (Base 1982=100) (source – data published from time to time Indian Labour Journal by the Labour Bureau, Government of India);

OR

(b) There be any variation in the All India Wholesale Price Index for all commodities (Base 199394=100) (as published from time to time in the RBI Bulletin based on the date issued by the Office of the Economic Advisor to the Government of India);

Price Variation Adjustment (PVA) towards (1) Labour Component and (2) Material Component shall be calculated in accordance with the formula A and B respectively, given below, subject to stipulations herein under mentioned:-

FORMULA (A) FOR LABOUR:

$$VL = 0.85P \times \frac{K1}{100} \times \frac{(C1 - C0)}{C0}$$

FORMULA (B) FOR MATERIALS:

$$VM = 0.85X\ (P-Y) \times \frac{K2}{100} \times \frac{(11 - 10)}{10}$$

Where-

VL = Amount of Price Variation Adjustment
Increase or decrease in rupees due to labour component

VM = Amount of Price Variation Adjustment
Increase or decrease in rupees on account of materials component

NOTE: Bill period (noted hereunder) signifies the period of actual execution and not date of measurement or preparation of bill.

P = Cost of work done during the period under consideration (bill period) excluding advances on materials and/or adjustments thereof.

Y = Cost of any other materials supplied/ arranged by the Bank at fixed price during the period under consideration (bill period)

K1 = Percentage of labour component calculated as indicated in Note (1) below.

K2 = Percentage of materials component as indicated in Note (2) below.

CO = Consumer Price Index – General Index Number for industrial workers (Base 1982 = 100) referred to at (a) above, ruling on the last due date of receipt of tenders, and as applicable to the centre, nearest to the place of work, for which the index is published).

10 = All India Wholesale Price Index number for all commodities referred to at (b) above, ruling on the last date for receipt of tenders and as applicable to the centre, nearest to the place of work for which the index is published.

11 = Average of above mentioned Consumer Price Index number during the period under consideration (bill period).

NOTE (1) : K1 shall be taken as under:-

Component of work	K1
(a) Civil work including ancillary works and external work and RCC / tanks, septic tanks, etc. if any of sanitary and plumbing work	30
(b) Sanitary and plumbing works including fittings and fixtures (internal work only)	20

c) Electrical installations work including fittings and fixtures (external and internal works) 20

NOTE (2) : K2 shall be taken as under:-

Component of work	K 2
a) Civil work including ancillary works as detailed under Note (1) (a) above	70
b) Sanitary and plumbing works including fittings and fixtures as detailed under Note (1) (b) above	80
c) Electrical installations work including fittings and fixtures as detailed under Note (1) (c) above	80

Stipulations:

(i) PVA Clause is operative either way i.e. if the variations in above referred price indices are on the plus side. PVA shall be payable to the contractor and if they are on the negative side PVA shall be recoverable from the contractor for the respective bill period of occurrence of fluctuations.

(ii) The rates quoted by the Contractor shall be treated as firm for the value of work required to be done in the first 12months of the contract period from the date of written order to commence work and no PVA is admissible on the same on any grounds whatsoever. The value of work required to be done during the first 12 months of the contract period shall be taken as 80% of the value of work to be done on pro-rata basis in 12 months as compared to the total stipulated completion period. No PVA is admissible on the value of work required to be done in first 12 months as worked out above, even if this value of work is actually done in a period longer than 12 months. However, in case of any delay in the first 12 months due to genuine reasons which are not attributable to the contractor and which are beyond his control, such period of delay will be deducted from 12 months, and the value of work to be done will be 80% of the pro-rata value of work to be done in such reduced period on pro-rata basis.

(iii) (a) For works where the original stipulated period of completion is not more than 12 months, no PVA whatsoever is permissible under this clause. However, if the period of completion is delayed beyond 12 months on account of genuine reasons which are not attributable to the contractor and which are beyond his control, PVA will be admissible on the value of work done only in excess of value of work required to be done on a pro-rata basis in the first 12 months minus the period of such genuine delay.

(b) For purpose of admissibility of PVA all the cumulative period of extensions granted for reasons which are solely attributable to the contractor is excluded from the total extended period of the contracts and PVA shall not be admissible on the value of work done during such period of extensions, which are granted for keeping the contract current, but only due to reasons for which the contractor was solely responsible. Periods of extensions granted on account of genuine reasons which are not attributable to the contractor and which are beyond his control will however, be included in the period for which PVA is admissible.

(c) Notwithstanding anything to the contrary mentioned in any other clause/ clauses of the contract, extensions of the contract period shall be granted by the Architect only with prior approval of the

Bank. Extensions granted by the Architect without Bank's prior approval shall not bind the Bank for payment of PVA for work done in the concerned period of extensions.

(i) (a) Where the total cost of work done beyond the value of work required to be done in the first 12 months (vide note (ii) and (iii) above does not exceed Rs.50 lacs the total amount of PVA worked out on the basis of provisions of foregoing stipulations will be limited to an upper ceiling of 10% of such value of work done in excess of value of work required to be done in the first 12 months, minus the cost of any materials issued/arranged by the Bank at fixed prices i.e. P – Y (these terms being as per definitions given formulae A and B above).

(b) Where the total value of work done beyond the value of work required to be done in the first 12 months exceeds Rs.50 lacs, the PVA on the first Rs.50 lacs will be calculated as provided for in the foregoing para and for the balance value of work done for which PVA is admissible subject to foregoing conditions, the PVA will have the upper ceiling of 10% but it will be worked out at a lower rate i.e. 80% of the amount worked out as per the formulae A and B referred to earlier.

(ii) In working out the amount of PVA as per all the foregoing stipulations, value of such extra items or such portions of extra items the rates of which are derived from the prevailing market rates of materials and labour will not be included in the value of work done. Value of only such extra items or such portions of extra items, rats of which are derived entirely from tendered rates will be included in the value of work on which PVA as calculated

(iii) For claiming the payment for PVA the contractor shall keep such books of accounts and other documents, vouchers receipts etc. as may be required by the Bank/Architect, for verification of the increased claims or reduction to be made as the case may be and he shall also allow Engineers and/or other duly authorized representatives of the Bank/Architects and furnish such information as may be required or called for to enable verification of the claim within a week of such request.

(iv) The contractor is required to submit to the Bank, through the Architect, his claims for PVA separately for each running Bill for the individual bill periods for the work paid to him by the Bank. He will also be required to submit detailed calculations in support of the claims.

(v) No claim will be entertained from the contractor for interest or any other grounds for non-payment or for any delay in payment of PVA due to late publication or non-availability of the necessary price indices or due to delay in preparation of the Running or Final Bills.

(vi) In view of adjustments for variations in process of materials and labour which have been covered in this clause no other adjustments for any reason whatsoever like statutory measures, taxes, levies, etc. will be allowed

43.0 **Force Majeure**

43.1 Neither contractor not SBI shall be considered in default in performance of their obligations if such performance is prevented or delayed by events such as war, hostilities revolution, riots, civil commotion, strikes, lockout, conflagrations, epidemics, accidents, fire, storms, floods, droughts, earthquakes or ordinances or any act of god or for any other cause beyond the reasonable control of the party affected or prevented or delayed. However, a notice is required to be given within 30 days from the happening of the event with complete details, to the other party to the contract, if it is not possible to serve a notice, within the shortest possible period without delay.

43.2 As soon as the cause of force majeure has been removed the party whose ability to perform its obligations has been affected, shall notify the other of such cessation and the actual delay incurred in such affected activity adducing necessary evidence in support thereof.

43.3 From the date of occurrence of a case of force majeure obligations of the party affected shall be suspended during the continuance of any inability so caused. With the cause itself and inability resulting there from having been removed, the agreed time of completion of the respective obligations under this agreement shall stand extended by a period equal to the period of delay occasioned by such events.

43.4 Should one or both parties be prevented from fulfilling the contractual obligations by a state of force majeure lasting to a period of 6 months or more the two parties shall mutually decide regarding the future execution of this agreement.

44.0 **Local Laws, Acts, Regulations:**

The contractor shall strictly adhere to all prevailing labour laws inclusive of contract labour (regulation and abolition act of 1970) and other safety regulations. The contractor shall comply with the provision of all labour legislation including the latest requirements of all the Acts, laws, any other regulations that are applicable to the execution of the project.

i) Minimum wages Act 1948 (Amended)
ii) Payment of wages Act 1936 (Amended) iii) Workmen's compensation Act 1923 (Amended)
iv) Contract labour regulation and abolition act 1970 and central rules 1971 (Amended) v) Apprentice act 1961 (amended)
vi) Industrial employment (standing order) Act 1946 (Amended)
vii) Personal injuries (Compensation insurance) act 1 963 and any other modifications viii) Employees' provident fund and miscellaneous provisions Act 1952 and amendment thereof ix) Shop and establishment act
x) Any other act or enactment relating thereto and rules framed there under from time to time.
xi) Prevailing Indian Electricity rules & act.

45.0 Safety Code:

Safety as per annexure 4.32 should be followed

46.0 **Accidents**

The contractor shall immediately on occurrence of any accident at or about the site or in connection with the execution of the work report such accident to the Architect/Consultant. The contractor shall also report immediately to the competent authority whenever such report is required to be lodged by the law and take appropriate actions thereof.

47.0 BANK'S BUILDING PROJECTS – MAINTENANCE OF RECORDS

A.	**Registers at the site office**
1	Measurement Books.
2	Cement Register (Daily Record).
3	Steel Register.
4	Steel Consumption Register – Bill wise.
5	Drawings register
6	Materials at site register.
7	Hindrance Register.
8	Concrete cube Test Register
9	File and Register for extra / variation items
10	Materials test Register and File
11	Site Order Book (in triplicate).
12	Lead caulking Register.
13	Labour Reports and progress Reports Register
14	Site Visit & Instructions Register
15	Certified true copies of the contracts

SPECIAL CONDITIONS OF CONTRACT

Scope of work

1.0 The scope of work is to carry out Interior works of State Bank of India Commercial building. (Interior works including of Civil, Electrical, HVAC, IT/ Data Cabling, Plumbing. Drainage & Waterproofing works).

2.0 **Address of site**

The site is located at 7th to 10th floor of SBI premises at NMMC C-Ward building, Vashi, Navi Mumbai.

3.0 **Dimensions and levels**

All dimensions and levels shown on the drawings shall be verified by the contractor at the site and he will be held responsible for the accuracy. Figured dimensions are in all cases to be accepted and dimension shall not be scaled. Large scale details shall take precedence over small scale drawings. In case of discrepancy the contractor shall ask for clarification from the Architect / consultant before proceeding with the work.

4.0 Building Permissions/ Statutory Approvals

The successful bidder/ contractor has to obtain necessary statutory approvals/ necessary permission from relevant Govt/ competent authority in consultation with Project Architect M/s Architect Narayan and Associates Pvt. Ltd. for carrying-out the captioned project works time-to-time on behalf of the Bank. For the purpose, Bank will reimburse the statutory charges/ cost as actual, on production of tax receipts/ invoices in original by the bidder/ contractor.

In absence of necessary permissions/ statutory approvals in place, Bank will be at liberty to levy penalties on the successful bidder/ contractor or ask the successful bidder/ contractor to demolish the unauthorized works on his risk & cost.

5.0 **Notice of operation**

The contractor shall not carry out any important operation without the Consent from the Bank's Engineer/Architect / Consultant:

6.0 **Construction records**

The contractor shall keep and provide to the Architect / consultant full and accurate records of the dimensions and positions of all new work and any other information necessary to prepare complete drawings recording details of the work as construction.

7.0 **Safety of adjacent structures and trees**

The contractor shall provide and erect to the approval of the Architect / consultant supports as may be required to protect effectively all structures and protective give to trees, which may be endangered by the execution of the works or otherwise such permanent measures as may be required by the Architect to protect the tree structures.

8.0 **Temporary works.**

Before any temporary works are commenced the contractor shall submit at least in advance to the architect / consultant for approval complete drawings of all temporary works he may require for the execution of the works. The contractor shall carry out the modifications relating to strength, if required by the architect / consultant may require in accordance with the conditions of contract at his own cost The contractor shall be solely responsible for the stability and safety of all temporary works and unfinished works and for the Quality of the permanent works resulting from the arrangement eventually adopted for their execution.

9.0 **Water power and other facilities**

a) The rate quoted by the contractor shall include all expenses that are required for providing all the water required for the work and the contractor shall make his own arrangements for the supply of good Quality water suitable for the construction and good Quality drinking water for their workers If necessary the contractor has to sink a tube well / open well and bring water by means of tankers at his own cost for the purpose The SBI will not be liable to pay any charges in connection with the above.

b) The rate quoted in the tender shall include the expenses for obtaining and maintaining power connections and shall pay for the consumption charges

c) The contractors for other trades directly appointed by the SBI shall be entitled to take power and water connections from the temporary water and power supply obtained by the contractor However, the concerned contractor shall make their own arrangements to draw the supply and pay directly the actual consumption charges at mutually agreed rates between them. All municipal charges for drainage and water connection for Construction purposes shall be borne by the contactor and charges payable for permanent connections, if any, shall be initially paid by the contactor and the SBI will reimburse the amount on production of receipts

d) The SBI as well as the Architect / consultant shall give all possible assistance to the Contractor's to obtain the requisite Permission from the various authorities, but the responsibility for obtaining the same in time shall be of the contractor

10.0 **Facilities for contractor's employees**

The contractor shall make his own arrangement for the housing and welfare of his staff and workmen including adequate drinking water facilities. The contractor shall also make the arrangements at his own cost for transport where necessary for his staff and workmen to and from site of work at his own cost.

11.0 **Lighting of works**

The contractor shall at all times provide adequate and approved lighting as required for the proper execution and supervision and inspection of work.

12.0 **Firefighting arrangements**

i) The contractor shall provide suitable arrangement for firefighting at his own cost. This purpose he shall provide requisite number of fire extinguishers and adequate number of buckets, some of which are to be always kept filled with sand and some with water these equipment's shall be provided at suitable prominent and easily accessible place and shall be properly maintained.

ii) Any deficiency in the fire safety or unsafe conditions shall be corrected by the contractor at his own cost and, to the approval of the relevant authorities. The contractor make the following arrangements at his own cost but not limited the following:

a) Proper handling, storage and disposal of combustible materials and waste.
b) Work operations which can create fire hazards.
c) Access for fire-fighting equipment's.
d) Type, number and location of containers for the removal of surplus materials and rubbish.
e) Type, size, number and location of fire extinguishers or other tire fighting equipment.
f) General house keeping

13.0 **Site order book**

A site order book shall be maintained at site for the purpose of quick communication between the Architect / Consultant. Any communication relating to the work may be conveyed through records in the site order book. Such a communication from one party to the other shall be deemed to have been adequately served in terms of contract Each site order book shall have machine numbered pages **in triplicate** and shall carefully maintained and preserved by the contractor and shall be made available to the architect / consultant as and when demanded- Any instruction which the architect /consultant may like to issue to the contractor or the contractor may like to bring to the architect / consultant two copies of such instructions shall be taken from the site order book and one copy will be handed over to the party against proper acknowledgment and the second copy will be retained for their record.

14.0 **Temporary fencing/ barricading**

The contractor shall provide and maintain a suitable temporary fencing / barricading and gates at his cost to adequately enclose all boundaries of the site for the protection of the public and for the proper execution and security of the work and in accordance with the requirement of the architect I consultant and regulations of local authorities. These shall be altered, relocated and adopted from time to time as necessary and removed on completion of the work.

15.0 **Site meetings**

Site meetings will be held to review the progress and Quality evaluation. There shall be a monthly Site meeting in presence of AGM (P&E) either on site or the Local Head Office of the Bank as per instructions and directions received from time to time. Apart from the monthly site meetings, weekly site meetings with the technical team of the project shall be held including progressive site meetings as and whenever required during the course of execution of works on site. The contractor shall depute a senior representative along with the site representative and other staff of approved sub-contractors and suppliers as required to the site meetings and ensure all follow up actions. Any additional review meetings shall he held if required by the architect/ consultant and the contractor along with his entire team shall remain present without fail.

16.0 **Disposal of refuse**

The contractor shall cart away all debris, refuse etc. arising from the work from the site and deposit the same as directed by the architect / consultant at his own cost. It is the responsibility of the contractor to obtain from the local authorities concerned to the effect that all rubbish arising out of contractor's activities at the construction site or any other off-site activities borrow pits has been properly disposed off.

17.0 **Contractor to verify site measurement**

The contractor shall check and verify all site measurements whenever requested other specialists contractors or other sub-contractors to enable them to prepare the own shop drawing and pass on the information with sufficient promptness as will in any way delay the works.

18.0 **Displaying the name of the work**

The contractor shall put up a name board of suitable size as directed by the architect/ consultant indicating therein the name of the project and other details as given by the architect/consultant at his own cost and remove the same on completion of work.

19.0 **As built drawings**

i) For the drawings issued to the contractor by the Architect / Consultant. The architect Consultant will issue two sets of drawings to the Contractor for the items for some changes have been made. From the approved drawings as instructed by the SBI/ architect / consultant. The contractor will make the changes made on these copies and return these copies to the architect / Consultant for their approval. In cases revision is required or the corrections are not properly marked the architect / Consultant will point out the discrepancies to the contractor. The contractor will have to incorporated these corrections and / or attend to discrepancies either on copies as directed by the architect / consultant and resubmit to him for approval. The architect / consultant will return one copy duly approved by him.

ii) For the drawings prepared by the contractor
The contractor will modify the drawing prepared by him wherever the changes made by the SBI / architect / consultant. And submit two copies of such modified drawings to the architect/ consultant for approval. The architect / consultant will return one copy of the approved drawing to the contractor.

20.0 Approved make
The contractor shall provide all materials from the list of approved makes at his own cost and also appoint the specialized agency for the waterproofing anti-termite, aluminium doors and windows and any other item as specified in the tender. The architect/consultant may approve any make / agency within the approved list as given in the tender after inspection of the sample/mock up.

21.0 **Procurement of materials**
The contractor shall make his own arrangements to procure all the required materials for the work. All wastages and losses in weight shall be to the contractors account

22.0 **Excise duty, taxes, levies etc;**
The contractor shall pay and be responsible for payment of all taxes, duties, levies, royalties, fees, cess or charges except GST in respect of the works including but not limited to sales tax, tax on works contract excise duty, and octroi, except GST payable in respect of materials, equipment plant and other things required for the contact. All of the aforesaid taxes, duties, levies, fees and charges except GST shall be to the contractor's account and the SBI shall not be required to pay any additional or extra amount on this account. Variation of taxes, duties, fees, levies etc if any except GST, till completion of work shall be deemed to be included in the quoted rates and no extra amount on this account. Variation of taxes, duties, fees, levies etc if any excluding GST, till completion of work shall be deemed to be included in the quoted rates and no extra claim on this account will in any case be entertained. If a new tax or duty or levy or cess or royalty or octroi is imposed under as statutory law during the currency of contract the same shall be borne by the contractor.

23.0 **Acceptance of tender**

The SBI shall have the right to reject any or all tenders without assigning any reason. They are not to bind to accept the lowest or any tender and the tenderer or tenderers shall have no right to question the acts of the SBI. However adequate transparency would be maintained by the SBI.

24.0 **Photographs:**

- The Contractor shall at his own expense supply to the Architects with duplicate hard copies of large photographs not less than 25 cm. x 20 cm. (10" x 8") or HD videographs of the works, taken from four approved portions of each floor , at intervals of not more than one months during the progress of the work or at every important stage of construction.

- In addition to above, the contractor shall be bound to submit adequate no. of site photographs along with their each Running Bill for the project clearing showing major progress of work measured and claimed therein failing which the Architect/Bank may consider returning the Bill to the contractor and no claim for delay on this account will be entertained.

25.0 **Corrupt Practices**

No representative of the Bank / Architect or any one directly or indirectly involved in this Works shall be offered by the **Contractor** or any of his Subcontractor, directly or indirectly, any benefit, fee, commission, dividend, gift or consideration of any kind in connection with the services and will not at any time offer gratuities or merchandise cash services or other inducement. The Contractor is aware of and familiar with the existence, provisions and purposes of the Anti-Bribery laws described below:

The prevention of corruption Act of 1998 (Indian Law) of the Indian penal code and the Foreign contribution (Regulation) Act of India (1976).

26.0 Liasoning with the Statutory Authorities

26.1 The Contractor shall be responsible for taking the approvals / NOC's from the statutory bodies like NMMC, MCGM, Building Proposal, Ward Office of NMMC, MCGM, CFO, CIDCO, Fire Departments, MHADA, Ward Offices or any other Statutory approval authority and the official charges of these departments shall be reimbursed by the bank on production of necessary documentary evidence in the form of challans & receipts. The successful contractor will indemnify the bank / Architect for any problems arising out of such approvals. All the expenses involved for getting such approvals / NOC's shall be paid by the contractor and no extra claim whatsoever shall be entertained. The Architect shall assist the contractor in coordination and making available the necessary drawings proposed by him for submission to the authorities, however the necessary follow-up & liasoning with these departments shall be the responsibility of the contractor. Any damage arising out of strict action of any of these departments shall be the sole liability of the contractor.

27.0 SAFETY RULES & PRECAUTIONS WHILE WORKING

1. All personnel at site should be provided with Helmets and Safety Boots with some Identification Mark. Visitors also should be provided with Helmets. It should be ensured that these are used properly.

2. First Aid Box should be kept at site with all requisite materials

3. No one should be allowed to inspect / work at a height without Safety Belt.

4. Suitable scaffolds should be provided for workmen for all Works that cannot safely be done from the ground, or from solid construction except such short period Work as can be done safely from ladders. When a ladder is used an extra Mazdoor shall be engaged for holding the ladder and if

the ladder is used for carrying materials as well as suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than ¼ to 1 (¼ horizontal and 1 vertical).

5. Scaffolding or staging more than 3.5 meters above the ground or floors, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise secured at least 1 Meter high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

5. Working platforms, Gangways, and Stairways should be so constructed that they do not sag unduly or unequally, and if the height of the platform or the Gangway or the Stairway is more than 3-5 Meters above ground level or floor level they should be closely boarded, should have adequate width and should be suitably fenced, as described.

6. Every opening in the floor of a building or in a working platform be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 1 Meter.

7. Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 Meters in length while the width between side rails in rung ladder shall in no case be less than 30cms for ladder up to and including Meters in length. For longer ladders this width should be increased at least 6mm for each additional 30 cms. Uniform step spacing shall not exceed 30 cms.

8. Adequate precautions shall be taken to prevent danger from electrical equipments. For electrical on line works gloves, rubber mats, and rubber shoes shall be used.

9. All trenches 1.2 Meters or more in depth shall at all times be supplied with at least one ladder for each 30 Meters length or fraction thereof. Ladder shall be extended from bottom of the trench to at least 1 Meter above the surface of the ground. The sides of the trenches, which are 1.5 Meters or more in depth shall be stepped back to give suitable slope, or securely held by timber bracing, so as to avoid the danger of sides collapsing. The excavated materials shall not be placed within 1.5 Meters of the edge of the trench or half of the depth of the trench whichever is more cuttings shall be done from top to bottom. Under no circumstances undermining or under cutting shall be done.

10. Before any demolition work is commenced and also during the process of the work :-

    a) All roads and open areas adjacent to the Work Site shall either be closed or suitably protected.
    b) No electrical cable or apparatus which is liable to be a source of danger over a cable or apparatus used by the operator shall remain electrically charged.

    c) All practical steps shall be taken to prevent danger to persons employed from risk or fire or explosion or flooding. No floor, roof or other part of the building shall be so over-loaded with debris or materials as to render it unsafe.

    d) All necessary personal safety equipment as considered adequate by the Site Engineer should be kept available for the use of the persons employed on the Site and maintained in a condition suitable for immediate use; and the Contractor should take adequate steps to ensure proper use of equipment by those concerned.

e) Workers employed on mixing Asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective goggles.

f) Those engaged in white washing and mixing or stacking of cement bags or any materials which is injurious to the eyes shall be provided with protective goggles.

g) Those engaged in welding works shall be provided with Welder's protective eye-shields.

h) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

i) When workers are employed in sewers and manholes, which are in use, the Contractor shall ensure that the manhole covers are opened and are ventilated at least for an hour before the workers are allowed to get into the manholes and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals and boards to prevent accident to the Public.

11. Use of hoisting machines and tackle including their attachments, anchorage and support shall confirm to the following standard or conditions: -

a) These shall be of good mechanical construction, sound material and adequate strength and free from patent defect and shall be kept in good repairs and in good working order.

b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in-charge of any hoisting machine including any scaffold, winch or give signals to the operator.

d) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension the safe working load shall be ascertained by adequate means.

e) Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of hoisting machine having a variable safe working load, each safe working load of the conditions under which it is applicable shall be clearly indicated. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

f) Motor, Gearing, Transmission, Electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards, hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load, adequate precautions should be taken to reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced.

g) When workers are employed on electrical installation, which are already energized, insulating mats, wearing apparel such as gloves, sleeves, and boots as may be necessary should be provided. The workers should not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.

13. All scaffolds, ladders and other safety devices, mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work.

14. **Observance of Contract Labour Act 1970**

Various provisions of the Contract labour Act 1970 and the rules made there under cast certain obligations on the Bank in respect of Bank's Projects under construction at various centers. Under the Act, the AGM/DGM of Premises/ Estate Department would be considered as the "Principal

Employer", even though the labourers are employed by the building contractor. The Act applies to every establishment in which twenty or more workmen are employed or were employed on any day of the preceding 12 months as contract labour. A workman shall be deemed to be employed as contract labour in connection with the work of an establishment when she/he is hired in connection with such work through a contractor with or without the knowledge of the principal employer.

However, in the cases of package deal agreements, it would not apply until the builder/vendor is deemed to be a contractor after execution of Deed of Conveyance, if so provided in the agreement. The Act also does not apply to the work of gardening, maintenance of residential colonies and services therein. Such arrangements need not be included in the records to be maintained under the Act and rules made thereunder. During the construction of a project the "Principal Employer" shall comply with certain provisions of the Act in so far as they are applicable to the particular case.
These provisions relate to-
(i) Registration of Establishment (Section 7).
The principal employer shall make an application to the registering officer in the prescribed manner for registration of establishment. The application for registration shall be made in triplicate in Form No.1 (Ref. Annexure 4.11) to the registering officer of the area in which the establishment sought to be registered is located. The application shall be accompanied by the Treasury receipt showing payment of fees for the registration of the establishment. The application shall be either personally delivered to the registering officer or sent to him by registered post. The employer can not employ the contract labour in his establishment unless he registers under Section 7 of the Act.
(ii) Maintenance of registers and other records (Section 29).
The following registers and records are required to be maintained by the Principal Employer:
a) Register of contractors in Form XII of the Contract Labour (Regulation & Abolition) Control Rules 1971 (Refer Annexure-4.12).

b) Notice showing the rates of wages, hours of work, wage period, dates of payment of wages, names and address of the Inspectors having jurisdiction and date of payment of unpaid wages, shall be displayed in English and in Hindi and in local language, in conspicuous places at the work site.

c) Return intimating the actual date of the commencement or completion of each contract work, under each contractor, shall be submitted to the Inspector within 15 days from the commencement or completion of the work as the case may be. The return shall be filed in Form No.VI B (Refer Annexure 4.13).

d) The annual return in duplicate in Form No. XXV (Annexure 4.14) shall be submitted to the Registering Officer concerned so as to reach him not later than the 15th February following the end of the year to which it relates.

All the registers, records and notices shall be produced on demand before the Inspector or any other authority under the Act.
(iii) Responsibility of payment of wages of workmen (Section 21).
Every principal employer shall nominate a representative duly authorized by him to be present at the time of disbursement of wages by the contractor and it shall be the duty of such representative to certify the amounts paid as wages in the prescribed manner. The authorized representative shall

record under his signature, a certificate at the end of the entries in the Register of wages or in the Register of wage and Muster Roll, in the following form.

"Certified that the amount shown in Column No. ____ has been paid to the workmen concerned in my presence on _____ at _____."

The Contractor shall be advised to disburse the wages in the presence of the authorized representative. If the contractor fails to make payment of wages within the prescribed period or makes short payment, the principal employer shall be liable to make payment of wages in full or the unpaid balance due to the contract labour employed by the contractor and recover the amount so paid from amounts payable to the contractors.

(iv) Welfare measures (Sections 16 to 19)
The welfare measures like canteen, rest rooms and other facilities to the contract labour are required to be provided by the contractor himself, but if any of the facilities is not provided by the contractor, then it shall be provided by the employer within 7 days of the commencement of the employment of contract labour. However, all expenses incurred by the Bank in providing the amenity shall be recovered from the Contractor either by deductions from any amount payable to the contractor or as a debt payable by the contractor.

(v) Penalty for contravention (Section 22 to 27).
a) Whoever obstructs an Inspector in the discharge of his duties under the Act or refuses or willfully neglects to afford the Inspector any reasonable facility for making any inspection, examination, enquiry or investigation authorised by or under the Act in relation to an establishment, shall be punishable with imprisonment for a term which may extend to 3 months or with fine which may extend to Rs.500/- or with both.

b) The contravention of any provision of the Act or of the rules made thereunder or contravention of any condition of a license granted under the Act is punishable with imprisonment which may extend to 3 months or with fine which may extend up to Rs.1000/- or with both.
The contractor shall ensure that all the obligations under the relevant provisions of the Act including obtaining licenses under Section 12 of the Act are complied with. Before releasing the contractor's final payment, it shall be ensured that the contractors have paid all dues to their contract labour.

ARTICLES OF AGREEMENT

(On non-judicial Stamp Paper of Rs. 500/-)

ARTICLES OF AGREEMENT made the _____ date of _____ between State Bank of India, having its office at Mumbai hereinafter called "the Bank" of the One Part and

_____

_____

_____

WHEREAS the Bank is desirous of _____

_____ and has caused drawings and specifications describing the work to be done to be prepared by M/s. Architect Narayan and Associates Pvt. Ltd.

AND WHEREAS the said Drawings numbered _____ to_____ inclusive, the Specifications and the Schedule of Quantities have been signed by or on behalf of the parties hereto.
AND WHEREAS the Contractor has agreed to execute upon and subject to the Conditions set forth herein and to the Conditions set forth herein in the Special Conditions and in the Schedule of Quantities and Conditions of Contract (all of which are collectively hereinafter referred to as "the said conditions") the works shown upon the said Drawings and / or described in the said Specifications and included in the Schedule of Quantities at the respective rates therein set forth amounting to the sum as therein arrived at our such other sum as shall become payable there under (hereinafter referred to as "the said Contract Amount.)

NOW IT IS HEREBY AGREED AS FOLLOWS:

1) In consideration of the said Contract Amount to be paid at the times and in the manner set forth in the said Conditions, the Contractor shall upon and subject to the said Conditions execute and complete the work shown upon the said Drawings and described in the said Specifications and the priced Schedule of Quantities.

2) The Employer shall pay to the Contractor the said Contract Amount, or such other sum as shall become payable, at the times and in the manner specified in the said Conditions.

3) The term "the Architects" in the said Conditions shall mean the said M/s. Architect Narayan and Associates Pvt. Ltd., or in the event of their ceasing to be the Architects for the purpose of this Contract for whatever reason, such other person or persons as shall be nominated for that purpose by the Employer, not being a person to whom the Contractor shall object for reasons considered to be sufficient by the Employer, PROVIDED ALWAYS that no person or persons subsequently appointed to be Architects under this Contract shall be entitled to disregard or overrule any previous decisions or approval or direction given or expressed in writing by the outgoing Architects for the time being.

4) The said Conditions and Appendix thereto shall be read and construed as forming part of this Agreement, and the parties hereto shall respectively abide by submit themselves to the said Conditions and perform the Agreements on their part respectively in the said Conditions contained.

5) The term Electrical Consultant refers to person or persons as may be appointed by the Architects with the approval of the Employer.

6) The Plans, Agreements and Documents mentioned herein shall form the basis of this Contract.

7) This Contract is neither a fixed lump-sum contract nor a piece work contract but a contract to carry out the work in respect of the entire building complex to be paid for according to actual measured quantities at the rates contained in the Schedule of Quantities and Rates or as provided in the said Conditions.

8) The Contractor shall be responsible for taking the approvals / NOC's from the statutory bodies like MCGM, Building Proposal, Ward Office of MCGM, CFO, CIDCO, Fire Departments, MHADA, Ward Offices or any other Statutory approval authority and the official charges of these departments shall be reimbursed by the bank on production of necessary documentary evidence in the form of challans & receipts. The successful contractor will indemnify the bank / Architect for any problems arising out of such approvals. All the expenses involved for getting such approvals / NOC's shall be paid by the contractor and no extra claim whatsoever shall be entertained. The Architect shall assist the contractor in coordination and making available the necessary drawings proposed by him for submission to the authorities, however the necessary follow-up & liasoning with these departments shall be the responsibility of the contractor. Any damage arising out of strict action of any of these departments shall be the sole liability of the contractor.

9) The Contractor shall afford every reasonable facility for the carrying out of all works relating to civil works, installation of lifts, Telephone, electrical installations, fittings air-conditioning and other ancillary works in the manner laid down in the said Conditions, and shall make good any damages done to walls, floors, etc. after the completion of his work.

10) The Employer reserves to itself the right of altering the drawings and nature of the work by adding to or omitting any items of work or having portions of the same carried out without prejudice to this Contract.

11) Time shall be considered as the essence of this Contract and the Contractor hereby agrees to commence the work soon after the Site is handed over to him or from 14th day after the date of issue of formal work order as provided for in the said Conditions whichever is later and to complete the entire work within 24 month including monsoon and public holidays subject to nevertheless the provisions for extension of time.

12) All payments by the Employer under this Contract will be made only at Mumbai.

13) All disputes arising out of or in any way connected with this Agreement shall be deemed to have arisen at Mumbai and only the Courts in Mumbai shall have jurisdiction to determine the same.

14) That the several parts of this Contract have been read by the Contractor and fully understood by the Contractor.

IN WITNESS WHEREOF THE EMPLOYER and the Contractor have set their respective hands to these presents and two duplicates hereof the day and year first hereinabove written.

SIGNATURE CLAUSE

SIGNED AND DELIVERED by the

_____ By the
(Employer)

hand of Shri _____

_____ (Signature of Employer)
(Name and Designation)

In the presence of :

1) Shri / Smt. _____ (Signature of Witness)

Address _____

_____
(Witness)

SIGNED AND DELIVERED by the

_____ by the
(Contractor) (Signature of Contractors)

in the presence of :

Shri / Smt. _____ (Signature of Witness)

Address _____

_____
(Witness)

APPENDIX HEREIN BEFORE REFERRED TO

1)	Name of the Client Offering Contract	:	The Deputy General Manager (Premises), Corporate Centre, Nariman Point, Mumbai 400021
2)	Consultants	:	**M/s Architect Narayan and Associates Pvt. Ltd.** Architects & Interior Designers,
3)	Site Address	:	C-Ward Building, Vashi, Navi Mumbai.
4)	Scope of Work	:	Proposed Interior works at 7th to 10th Floors of SBI premises at C-Ward Building Vashi, Navi Mumbai
5)	Name of the Contractor	:	---------- ---------- ----------
6)	Address of the Contractor	:	---------- ---------- ----------
7)	Period of Completion	:	**03 months** from the work order. **(Including monsoon and public holidays)**
8)	Earnest Money Deposit	:	**Rs.13,78,000/- (Rupees Thirteen Lakh Seventy Eight Thousand Only)** By means of Demand Draft / Pay Order (Valid for a period of 90 Days from the last date of submission of the tender) from any scheduled Nationalized Bank drawn in favour of State Bank of India, payable at Mumbai.
9)	Retention Money	:	As per the relevant clause of general Conditions.
10)	Defects Liability Period	:	Twelve Months from the date of Virtual Completion.
11)	Insurance to be undertaken by the Contractor at his cost	:	125% of Contract Value (Contractor's all-risk policy) Workmen Compensation Policy

12)	Liquidated damages	:	0.5% of the estimated amount shown in the tender per week max. 5% of the contract value.
13)	Value of Interim Bill (Min.)	:	**Rs. 3.00 Crores** (**Rs. Three Crore Only**)
14)	Period of Final Measurement	:	2 (Two) Months from the date of Virtual Completion.
15)	Initial Security Deposit	:	2% of the Accepted Value of theTender. (pertaining to the relevant clause)
16)	Total Security Deposit	:	Total security deposit i.e. the ISD plus Retention Money shall both together not exceed 5% of the contract value
17)	Refund of initial Security Deposit Comprising of EMD and ISD.	:	50% of the Security Deposit shall be refunded to the Contractor on completion of the work and balance refunded only after the Defect Liability Period is over.
18)	Period for Honoring Certificate	:	1. 10 working days for R.A. Bills 2. The final bill will be submitted by the Contractor within one month of the date and the Bill shall be Certified within two months from the date of receipt of final bill provided the bills are submitted with all pre-requisite documents/test reports etc prescribed in the tender.

_____

Signature of Tenderer.

Date:

INDEX PROFORMAS OF VARIOUS TESTS

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TABLE-I

RECORD OF CEMENT RECEIVED / USED / BALANCE

S. No.	Cement in stock Bags	Cement received (Bags)	Total Cement received (Bags)	Source from which received	Description of work Where cement is used	Number cement bags consumed	Balance in stock	Signature of Contractors Bank / Engineer
1	2	3	4	5	6	7	8	9

Signature & Seal of Contractor

TABLE-II

RECORD OF PAINT / LEAD / CICO REGISTER

Name of work :

Name of the Contractor :

Agreement No. :

Date of Receipt	Source Receipt with Ref. To S.O./Indent	Qty. Received	Progressive Total	Item of work for which issued with approx. qty. work done in case of paint only	Date of issues	Quantity issued	Qty. returned at the end of the day	Total issued	Delay Balance at hand	Contractors initials	Site Engineers initials	Signature of Banks/ Architect
1	2	3	4	5	6	7	8	9	10	11	12	13

Register for bitumen should be maintained. The format will be similar to that for cement.

Signature & Seal of Contractor

TABLE-III

RECORD OF REINFORCEMENT BARS RECEIVED

Truck No.	Challan No.	Name of Supplier	Binding Wire	6mm dia.	8mm dia.	12mm dia.	16mm dia.	20mm dia.	25mm dia.	Total Received
1	2	3	4	5	6	7	8	9	10	11

Number of diameters given is only illustrative. Open more columns for other diameters wherever needed.

Signature & Seal of Contractor

TABLE-IV

PROFORMA FOR REGISTER OF MATERIAL AT SITE ACCOUNT

Name of Work :

Name of Article :

Name of Contractor :

Estimated Requirement :

Agreement No. :

Issue Rate :

Date Receipt	Received from/Issued to (with Ret. to So/Indent)	Receipt	Issue	Balance	Initials Contractor	Initial of Bank's/ Architect's representative	Remark
1	2	3	4	5	6	7	8

Signature & Seal of Contractor

TABLE-V

PROFORMA FOR ACCOUNT OF SECURED ADVANCE REGISTER.

Name of Work :

Name of Contractor :

Agreement No. :

Description of Material	Qty. outstanding from previous Bill	Deduct Qty. utilised in works measured since previous bill	Qty. outstanding & Qty. brought to site since previous bill	Signature of Site Engineer	Signature Contractor	Initial of Bank's/ Architect's representative	Remark
1	2	3	4	5	6	7	8

Signature & Seal of Contractor

TABLE-VI

PROFORMA FOR BULKAGE TEST OF SAND REGISTER

Sr. .No.	Date of Test	Volume of dust sand in Cylinder inundated & stirred	Volume inundated Sand in Cylinder	Percentage of Bulkage	Signature of Site Engineer	Signature of Contractor	Initial of Bank's Architect's representative (Periodical)
1	2	3	4	5	6	7	8

Signature & Seal of Contractor

TABLE-VII

PROFORMA OF SILT TEST REGISTER

Sr. No.	Date of Test	Height of Sand in Cylinder inundated& stirred	Height Silt	Max percentage of silt as specified	Percentage of silt obtained	Signature of Site Engineer	Signature of Contractor	Initial of Bank's / Representative (Periodical)
1	2	3	4	5	6	7	8	9

Signature & Seal of Contractor

TABLE-VIII

PROFORMA SIEVE ANALYSIS OF FINE AGGREGATE REGISTER

Sr. No	Date of Test	Wt. of Material to be tested	Sieve as per I.S. designation	Wt. of Sand retained in sieve	%a retained in each sieve successively	Cumulative % retained in each sieve	F.M.	Signature of Site Engineer	Signature of Contractor	Signature of Banks/ Architect's representative & Remarks (Periodical)

Signature & Seal of Contractor

TABLE-IX

PROFORMA OF SIEVE ANALYSIS OF COARSE AGGREGATE REGISTER

S. No.	Date of Testing	Wt. of Material to be tested	Nominal size of Aggregate	I.S. Sieve designation	Standard passing for graded aggregate. of nominal size	Test Result	Obtained passing	Signature of Site Engineer	Signature of Contractor	Signature of Banks/ Architect's representative & Remarks (Periodical)
1	2	3	4	5	6	7	8	9	10	11

Signature & Seal of Contractor

TABLE-X

PROFORMA FOR SLUMP TEST REGISTER

Sr. No	Date of Testing	Type of work for which slump taken	Specified slump		Slump Obtained		Signature of Site Engineer	Signature of Contractor	Signature of Banks/ Architect's representative & Remarks (Periodical)
			When Vibrators are used	When Vibrators are not used	When Vibrators are used	When Vibrators are not used			
1	2	3	4	5	6	7	8	9	10

Signature & Seal of Contractor

TABLE-XI

PROFORMA OF CUBE TEST REGISTER

Date taking Cube Lime	Sampl No.	No. of Cube taken	Specifi markin of Cub	Proport n emixtur	Descri on ework carried out	Signature of Engineer taking sample	Signa ture Contra ctor	7/28 Days Testing				Permissible Compress i strength of Concrete / 28 Days / 7 days		Remarks on Test Report and No.	Remarks of Banks/ Architects representa tive Periodical
								Date of Test	Test Result Kg/ Sq.cm	Av. Stren-gth Kg. / Sq.cm.	Strandard strength Kg / Sq.cm.	7 Days	28 Days		
1	2	3	4	5	6	7	8	9	10	11	12	13		14	15

Signature & Seal of Contractor

TABLE-XII

PROFORMA FOR HINDRANCE TO WORK

Name of Work : Date of Start of work :

Name of Contractor : Period of Completion : Agreement No. : Dt. of Completion of work

:

S.No.	Nature Hindrance	Date of Occurrence Hindrance	Date of which Hindrance was removed	Period of which Hindrance existed	Signature of Site Engineer	Signature of Bank / Architects Representative
1	2	3	4	5	6	7

Signature & Seal of Contractor

PROFORMA FOR RUNNING A/C BILL

i.	Name of Contractor / Agency	:
ii.	Name of Work	:
iii.	Sl.No. of this Bill	:
iv.	No. & Date of previous Bill	:
v.	Reference to Agreement No.	:
vi.	Date of Written order to commence	:
vii.	Date of Completion as per Agreement	:

S.No.	Item Description	Unit	Rate (₹)	As per Tender	
				Quantity	Amount (₹)
1	2	3	4	5	

Upto Previous R.A. Bill		Up Date (Gross		Present Bill		Remarks
Quantity	Amount (₹)	Quantity	Amount (₹)	Quantity	Amount (₹)	
6		7		8		9

Note: 1. If part rate is allowed for any items, it should indicated with reasons for allowing such a rate

2. If ad-hoc payment is made, it should mention specifically.

_____

_____

Net Value since previous bill

Signature & Seal of Contractor

CERTIFICATE

The measurements on the basis of which the above entries for the Running Bill No. ---------- were made have been taken jointly on ---------- and are recorded at pages ---------- to ---------- of measurement book No. ----------.

----------	----------	----------
Signature and date of Contractor	Signature and date of Architects Representative(Seal)	Signature and date of Site Engineer

The work recorded in the above-mentioned measurements has been done at the site satisfactorily as per tender drawings, conditions and specifications.

----------	----------
Architect	Signature and date of Site Engineer

TABLE - XIV

ACCOUNT OF SECURED ADVANCE, IF ADMISSIBLE ON MATERIALS HELD AT SITE BY THE CONTRACTOR

S.No.	Item	Quantity	Unit	Amount	Remarks
1	2	3	4	5	6

Total value of materials at Site.

Secured Advance @ ---------- of above value - B

CERTIFIED:

(i) That the materials mentioned above have actually been brought by the Contractor to the site of the work and on advance on any quantity of any of this item is outstanding on their security.

(ii) That the materials (are of imperishable nature) and are all required by the Contractor for use in the work in connection with the items for which rates of finished work have been agreed upon.

Dated Signature of
Site Engineer
Preparing the bill
Rank ----------

Date signature of
Banks Architects---------- (Name
of the Architects)

Dated Signature of
the Contractor

TABLE - XV

MEMORANDUM FOR PAYMENT

R/A BILL NO.

1.	Total value of work done since previous bill (A)	₹ ----------	
2.	Total amount of secured advance due since Previous Bill (B)	₹ ----------	
3.	Total amount due since Previous Bill (C) (A+B)	₹ ----------	
4.	PVA on account of declaration in price of Steel, Cement and other materials and labour as detailed in separate statements enclosed.	₹ ----------	
5.	Total amount due to the Contractor	₹ ----------	

OBJECTIONS:

i)	Secured Advance paid in the previous	₹ ----------	R/A
ii)	Retention money on value of works as per accepted tenders upto date amount ₹	₹ ----------	
	Less already recovered	₹ ----------	
	Balance to be recovered	₹ ----------	
iii)	Mobilization Advance, if any		
(a)	Outstanding amount (principal + interest) as on date	₹ ----------	
(b)	To be recovered in this bill	₹ ----------	
iii.	Any other Departmental materials cost to be recovered as per contract, if any	₹ ----------	
iv.	Any other Departmental service charges to be recovered if any, as per contract (water, power etc.) enclose statement.	₹ ----------	

Total Deduction as per contract (F) ₹ ----------

Adjustments, if any ---------- Amount less received by Contractor in -------- R/A Bill (as per statement of Contractor) ₹ ----------

P.V.A. ₹ ----------

Total amount payable as per contract (E+F+G) ₹ ----------

(Rupees ---------- in words)

The bill amount to ₹ ---------- (both figures and words) has been scrutinized by us after due checking of the measurements of work as required and is recommended for payment.

Date: ----------

Signature of Architect
with Seal

The bill amount to ₹ ---------- certified by Consultants has been scrutinized by me after due test checking of measurements of works as required and is recommended for payment for an amount of ₹.....

Date : ----------

Signature of Owners
Engineer

STATUTORY DEDUCTION:

i) Total Amount due (E) ₹ ----------

ii) Less I.T. Payable ₹ ----------

iii) Less S.T. Payable ₹ ----------

Net Payable ₹ ----------

These figures given in the Memorandum for payable has been verified and bill passed for payment ---------- ---------- (in words and figures)

Date: ----------

Deputy General Manager (Premises)

MODE OF MEASUREMENT

1. Unless otherwise stated, all pipes shall be measured net, length as laid and measured overall fittings, such as bends, junctions, etc., and given in running meters. The length shall be taken along the centre line of the pipes and fittings.

2. Length of fittings viz, taps, valves, traps etc., which are paid under appropriate items shall not be remeasured under linear measurements as enumerated above.

3. Soil waste and vent pipes shall be measured along the centre line of the stack including the connecting bends/tees to W.C. Pan, Nahani trap, etc. and shall be paid as enumerated above.

4. W.C. Pans, Lavatory basins, Sinks, drain boards, Urinals, Mirrors, Glass shelf Toilet paper Holder, shall be measured by number and shall include all accessories as enumerated in detail specification under each item.

5. Unless otherwise specified, all types of taps, valves, etc., shall be measured by number and paid separately.

6. Manholes, inspection Chambers, Gully traps, etc. shall be constructed according to detail specification and measured by number and paid separately. The depth of Manhole shall mean the vertical distance from the top of the Manhole cover to the outgoing invert of the main drain channel.

7. Water meter shall include Y strainer and other appurtenances required by the local bodies and shall include brick masonry chamber, etc., as per detailed specifications and item shall be measured by number and paid for accordingly or as per schedule of quantity.

---00--

TECHNICAL SPECIFICATION (CIVIL & ALLIED SERVICES)

SECTION – A: MATERIALS

1) Material shall be of best approved quality obtaining and they shall comply with the respective Indian Standard Specification.
2) Samples of all materials shall be got approved before placing order and the approved sample shall be deposited with the Architect.
3) In case of non-availability of materials in metric sizes the nearest size in FPS units shall be provided with prior approval of the Architects for which neither extra will be paid nor shall any rebates be recovered.
4) If directed, materials shall be tested in any approved Testing Laboratory and the test certificates in original shall be testing including charges for repeated tests, if ordered, shall be borne by the Contractor.
5) It shall be obligatory for the Contractor to furnish certificate, if deemed by the Architects, from manufacturer or the material supplier that the work has been carried out by using their material and as per their recommendations.
6) All materials supplied by the Employer / any other Specialist Firms shall be properly stored and the Contractor shall be responsible for its safe custody until they are required on the works and till the completion of the work.
7) Unless otherwise shown on the Drawings or mentioned in the "Schedule of Quantities" or special specification, the quality of materials, workmanship, dimensions, etc., shall be as specified as hereunder.
8) All equipment and facilities for carrying out field tests on materials shall be provided by the Contractor without any extra cost.

a) **Cement:**

Cement shall comply in every respect with the requirements of the latest publications of IS: 269 and unless otherwise specified ordinary Portland Cement shall be used.

The weight of ordinary Portland Cement shall be taken as 1440 kg. per cu.m. (90 lbs. per c.ft.). Cement shall be measured by weight and in whole bags, and each undisturbed and sealed 50 kg. bag being considered equivalent to 35 liters (1.2 c.ft.) in volume care should be taken to see that each bag contains full quantity of cement. When part bag is required cement shall be taken by weight or measured in measuring boxes.

No other make of cement but that approved by the Architects will be allowed on works and the source of supply will not be changed without approval of Architect in writing. Test certificates to show that cement is fully complying the specifications shall be submitted to the Architects and notwithstanding this, the Architect may at his discretion, order that the cement brought on site and which he may consider damaged or of doubtful quality for any reason whatsoever, shall be re-tested in an approved testing laboratory and fresh certificates of its soundness shall be produced.

Cement ordered for re-testing shall not be used for any work pending results of re-test.

Cement shall be stored in weather-proof shed with raised wooden plank flooring to prevent deterioration by dampness or intrusion of foreign matter. It shall be stored in such a way as to allow the removal and use of cement in chronological order of receipt i.e., first received being used first used. Cement deteriorated and or clotted shall not be used on the work but shall be removed at once from the site. However, allowing use of warehouse set cement shall be determined by the Architects.

b) **Lime:**

Lime shall comply in every respect with the requirements of IS: 712 and shall be made from approved line stone or kankar and properly burnt. It shall be free from excess of unburnt kankars or lime stone ashes or other extraneous materials and shall be stored in weather-proof sheds. Lime which has damaged by rain, moisture, or air slacking shall not be used but shall be removed from the site of work forthwith. Lime shall be slacked with fresh water and screened through appropriate screens and stored and used within 14 days provided it is protected from drying out.

Field tests according to IS: 1624 shall be carried out from time to time to determine the quality of lime.

c) **River Sand:**

River sand shall confirm to IS: 383 and relevant portion of IS: 515. It shall pass through pass through a I.S. sieve 4.75 mm. (3/16 B.S.) test sieve, leaving a residue not more than 5%. It shall be from natural source i.e. only river or crushed stone screenings, if allowed, chemically clean, sharp, hard durable, well graded and free from dust, pebbles, clay, shale, salt, organic matter, loam, mica or other deleterious matter. The sum percentages of all deleterious substances to acceptable limits. River sand shall not contain any trace of salt and it shall be tested and river sand containing any trace of salt shall be rejected.

The fine aggregate i.e. river sand for concrete shall be graded within limits as specified in IS: 383 and the fineness Modules may range between 2.60 to 3.20.

The fine aggregate shall be stacked carefully on a clean hard dry surface so that it will not get mixed up with deleterious foreign materials. If such a surface is not available a platform of planks or corrugated iron sheets or brick floor or a thin layer of lean concrete shall be prepared.

d) **Fine & Coarse Aggregate:**

Shall consist of crushed or broken stone 95% of which shall be retained on 4.75 mm. IS tests sieve. It shall be obtained on crushing Granite, Quartzite, Trap, Basalt, or similar approved stones from approved quarry and shall confirm to IS:383 and IS 515. Fine & Coarse aggregate shall be chemically inert when mixed with cement and shall be cubical in shape and be free soft, friable, thin, porous, laminated or flaky pieces. It shall be free from dust and any other foreign matter.

Gravel / Shingle of desired grading may be permitted as a substitute in part or full in plain cement concrete if the Architect is otherwise satisfied about the quality of aggregate. For all the R.C.C. works the size of coarse aggregate shall be 20 to 25 mm. and fine aggregate shall be 10 to 15 mm.

e) **Reinforcement:**

Reinforcement shall be of mild steel tested quality confirming to I.S.: 432-1966 and any other I.S. applicable or deformed bar confirming to IS:1786 and Is:1139 or hard drawn Fe 415 (Tor Steel) steel wire fabric confirming to IS:1566;1967.

All finished bars shall be free from cracks, surface flaws, laminations, jagged and imperfect edges.

f) **Bricks :**

Bricks shall generally comply with IS:1077 except in size which shall be classified as 1st and 2nd class.1st class bricks shall be the best quality locally available table moulded, well burnt but not over burnt, have plain rectangular faces with parallel sides and sharp right-angled edges, have a find compact and uniform texture. The bricks shall be free from cracks, chips, flaws, stones or subsequent to soaking in water. It shall emit a clear ringing sound on being struck and shall not absorb water more than 20% by weight. Common building bricks shall have a compressive strength of 35 kg. / sqm unless otherwise specified for first class bricks.

g) **Neeru:**

Shall be made of Class "C" Lime (i.e. pre-fat lime) as mentioned in IS: 712. It shall be slaked with fresh water then sifted and reduced to a thick paste by grinding in a mill. Neeru thus prepared shall be kept moist until used and no more than that can be consumed in 15 days shall be prepared at time.

h) **Surkhi :**

Shall be made by grinding well burnt bricks, brick bats, burnt clay balls, etc., the brick etc., to be used shall be prepared from selected clay. The quality shall confirm to IS:1344.

Bricks bats, etc., shall be ground in mechanical disintegrator to a find powder passing through IS Sieve No. 9 (2.36 mm.) with a residue not exceeding 10% by weight.

Surkhi for lime surkhi plaster shall be ground to fine powder in a mortar mill to pass through IS Sieve 150 micron (No. 100)

Surkhi shall be stored in a weather-proof shed on a brick pave platform.

i) **Water :**

Water for mixing cement / lime / surkhi mortar or concrete shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil, acid and injurious alkali, salts, organic matter and other deleterious materials which will either weaken the mortar or concrete or cause affluence or attack the steel in reinforced cement concrete. Water shall be obtained from sources approved by the Architect. Potable water is generally considered satisfactory for mixing and curing concrete, mortar masonry, etc., where water other than main source is used this shall be tested in an approved testing laboratory to establish its suitability. All charges connected therewith shall be borne by the Contractor.

j) **Timber :**

Timber shall be well seasoned and of the best quality Indian Teak of specified species viz., Dandeli, Balarshah, Melabar, C.P.

Timber shall be considered as well seasoned, if its moistures content does not exceed the following limits.

a) Timber for frames 14%

b) Timber for planking, shutters, etc. 12%

The moisture content of timber shall be determined according to method described in paragraphs 4 of IS:287 for Maximum permissible moisture content of timber used for different purpose in different climatic zones.

In measuring cross-sectional dimensions of the frame pieces tolerance up to 1.5 mm. shall be allowed for each planed surface.

k) **Superior quality Indian Teak Wood :**

Superior quality Indian Teakwood means Dandeli, Balarshah, and Malabar Teak. It shall be of good quality and well-seasoned. It shall have uniform colour, reasonably straight grains, and shall be free from large.

Loose, dead knots, cracks, shakes, warp, twists, bends, borer holes, sap-wood or defects of any kind. No individual hard and should knot shall be more than 1 cm. in diameter and aggregate areas of all knots shall not exceed ½% of area of the piece. There shall not be less than 6 growth rings per 2.5 cm. width.

l) **1st Class Indian Teakwood :**

1st Class Indian Teakwood means C.P. and Bulsar teak of good quality and well-seasoned. It shall have uniform colour, reasonably straight grains and shall be free from large. Loose dead knots, cracks, shakes, warp, twists, bends, sap-wood or defects of any kind. No individual hard and should knot shall be more than 2.5 cm. in diameter and aggregate areas of all the knots exceed 1% areas of the piece. There shall not be less than 5 growth tings per 2.5 cm. width.

m) **2nd Class Indian Teakwood :**

Shall be similar to first class Indian teak wood except that knot up to 4 cm. diameter and aggregate area of all knots up to 1 ½% of the area of the piece shall be allowed. There shall not be sapwood up to 15% is allowed.

n) **Flush Doors :**

All flush doors shall be solid core exterior grade unless otherwise specified and it shall generally confirm to IS:2202 and shall be fabricated as described under specification.

o) **Steel Windows and Doors :**

Steel windows and doors shall be fabricated of steel sections conforming to IS:226. They shall conform to IS 1038. Unless otherwise specified the details of construction etc., shall be as described under specification.

p) **Vitrified Tiles :**

Vitrified tiles shall comply with IS:777 or relevant or latest I.S. code. It shall be from an approved manufacturer and shall be flat and true to shape. They shall be free cracks, crazing, spots, chipped edges and corners. The glazing and colour shall be uniform shade and unless otherwise specified the tiles shall be 9 mm. thick.

q) **Marbles :**

Marble slabs for flooring, dado veneering etc., shall be of kind specified in the item such as white or pink, Makrana, Chittor black, Bhanslana black, Jaisalmer yellow, Baroda green, Patiala (Pepsu) grey, etc., Marble from which slabs are made shall be selected quality, hard, sound dense and homogenous in texture and free from cracks, weathering, decay and flaws. Before starting the work, the contractor shall get the sample of Marble slabs approved by the Architect.

The slabs shall be machine cut and machine polished.

r) **Kotah / Shahabad / Cudappa / Granite :**

Shall be of selected quality, hard, sound, dense, and of homogenous texture, free from cracks decay, weathering and flaws. Stone slabs shall be of uniform colour as approved by the Architect. They shall be machine cut and machine polished where specified and shall confirm to the required size. Thickness shall be specified in the respective items.

s) **Glazing :**

Glass used for glazing shall be float glass of best quality, free from flaws, specks bubbles and shall be 2.9 mm. thick up to 0.60 x 0.60 mm. size and for larger size it shall be 4 mm. thick unless otherwise specified in the Schedule of Quantities.

The following type of glasses shall be used:-

1) For Office Building	Clear glass or as specified in the Schedule of Quantities.
2) Office (toilets)	Clear or frosted
3) Partitions	Frosted

t) **Paints :**

Lime for lime wash, dry distemper, oil bound distemper cement primer, oil paint, enamel paint, flat oil paint, plastic emulsion paint, anti-corrosive primer, red lead, water-proof cement paint and exterior grade Acrylic Emulsion paint, cement paint, sand-tex matt shall be from an approved manufacturer and shall conform to the latest Indian Standard for various paints. Ready mixed pains as received from the manufacturer without any admixture shall be used, except for addition of thinner, if recommended by the manufacturer.

u) **Mortar :**

Lime Surkhi Mortar :

Lime and surkhi shall confirm to the specifications. It shall be composed of approved lime and surkhi in proportion of 1 lime to 2 surkhi mixed thoroughly. The ingredients shall be accurately gauged by measure and

shall be well and evenly mixed together on a platform and water added to make it homogenous. When large quantities are required the mortar shall be mixed in a mechanical grinder.

Cement Mortar :

Cement mortar shall be of proportions specified for each type of work in the schedule. It shall be composed of Portland Cement and sand. The ingredients shall be accurately gauged by measure and shall well and evenly mixed together in a mechanical pan mixer, care being taken not to add more water than is required. No mortar that has begun to set shall be used. River sand shall be used unless otherwise specified.

If hand mixing is allowed, then it shall be done on pucca water-proof platform. The gauged materials shall be put on the platform and mixed dry. Water will then be added and the whole mixed again until it is homogenous and of uniform colour. Not more than one bag of cement shall be mixed at one time and which can be consumed within half an hour of its mixing.

Composite Lime, Cement, Sand Mortar :

The mortar shall be of proportions specified for each type of work in the schedule of quantities. It shall comprise of Portland cement, lime and sand. Lime shall be measured in gauge boxes similar to one used for measuring cement and sand to the proportion specified and sufficient water then added to it to form a thick slurry thus obtained shall then be added to dry cement and sand mixture and thoroughly mixed to make a workable homogenous mortar of uniform colour by adding more water if necessary. Mechanical ixersshall generally be used for mixing such mortars. If hand mixing is allowed it shall be done on pucca platform.

Note :

In connections with the I.S. Code numbers indicated under Section, Specification, Section A – General
Refer to the following I.S. Code numbers and the year and or otherwise latest modified I.S. Code Number.

1) Cement	:	I.S. 269 – 1976
2) Lime	:	I.S. 712 – 1964
		I.S. 1624 – 1960
3) Fine – Aggregate	:	I.S. 383 – 1970
4) Coarse – Aggregate	:	I.S. 515 – 1970
5) Reinforcement	:	I.S. 432 – 1966 Fe 415
		I.S. 1786 – 1966 (Tor Steel)
		I.S. 1139 – 1966
6) Bricks	:	I.S. 1077 – 1970
7) Neeru	:	I.S. 712 – 1964
8) Surkhi	:	I.S. 1344 – 1968
9) Timber	:	I.S. 287 – 1960
10)Flush Doors	:	I.S. 2202 – 1966
11)Floor Tiles	:	I.S. 1237 – 1980
12)Ceramic / Vitrified Tiles	:	I.S. 777 – 1970
13) Asbestos Roofing and Rainwater pipes	:	I.S. 459 – 1962
14) R.C.C. design mix M-25	:	I.S. 456 – 2000

SECTION – B: MODE OF MEASUREMENTS

The method of measurement for various items in the tender shall be generally in accordance with the IS: 1200 subject to the items for which the mode of measurements is not given under or elsewhere in the tender.

1) **Cement Concrete (Plain & Reinforcement)**:

Cement concrete in R.C.C. and P.C.C. items shall be measured exclusive of reinforcement and plaster thickness but shall include necessary costs of shuttering, centering, hire charges of all equipment, curing, hacking and fair finish. Reinforcement and plaster shall be measured and paid separately.

Items line R.C.C. precast jalli, R.C.C. pipes and other such items which are normally manufactured in factories as well as those items which have been specifically mentioned in the Schedule of Quantities shall be measured inclusive of reinforcement.

No deductions will be made for openings up to 0.1 sq.mtr. and no extra labour for forming such openings or voids shall be paid.

Columns shall be measured from face to face of columns / beams and shall include haunches, if any. The depth of the beams (other than raft foundations beam) shall be measured from the top of the slab to the bottom of the beam.

2) **Reinforcement**:

Shall be measured in lengths of bars as actually placed in position on standard weight basis; no allowance being made in the weight for rolling margin, Wastage and binding wire shall not be measured, authorised overlaps and spacers shall only be measured.

Standard weight for steel reinforcement bars

Diameter of the steel ba in mm.	6	8	10	12	16	20	25	32
Weight of steel bars in per Rmt.	0.22	0.39	0.62	0.89	1.58	2.47	3.85	6.31

3) **Brick Work** :

Except walls of half-brick thickness or less, all brick work shall be measured in cubic meters.

Thickness of Wall:

Brick walls up to and including three bricks in thickness shall be measured in multiples of half-brick which shall be deemed to be inclusive of the mortar joints. Where fractions on half-bricks occur due to Architectural or other reasons, the measurement shall be taken half-bricks.

For walling, which is more than three bricks in thickness, the actual thickness of the wall be measured to the nearest centimeter.

Honey-combed brick walling shall be given in square meters stating the thickness of wall and the pattern of honey-combing. Honey comb openings shall not be deducted.

Deductions:

No deductions or additions shall be made on any account for

a) Ends of dissimilar materials (i.e. joists, beams, lintels, lofts, grinders, rafters, purlins, trusses, corbels, steps, etc.) up to 500 square centimeters in section.
b) Opening up to o.1 sq. in section.
c) Wall plates, bed plates and bearing of slabs, chajjas and the like where the thickness does not exceed 10 cm. and the bearing does not extend over the full width of the wall.

4) **Stone Masonry** :

Except where otherwise described, stone work and stone walling generally shall be given in cubic meters and facia work in square meters.

When measuring walls, the thickness shall be measured to the nearest one centimeter.

Deductions shall be made as described under brick work.

5) **Wood Work**:

All work shall be measured net as fixed. No extra measurement will be given for shape, joints, splayed meeting styles of doors and windows and shall be measured in unit of square meters.

Area over the face inclusive of exposed frame thickness (excluding width of cover mould) shall be measured in case of door, windows and ventilators when frames are included in the item. Portions embedded in masonry or flooring shall not be measured. Where frames are measured separately mode of measurement shall be as per C.P.W.D. practice or IS:1200.

6) **Steel doors, windows, ventilators, louvers**:

Clear area over one face inclusive of exposed frame shall be measured. Holdfasts or portions embedded in masonry or flooring shall be measured.

7) **Flooring, Skirting, Dado**:
Flooring shall be measured from skirting to skirting and where the wall surface is plastered or provided with Dado, it shall be measured from plaster to plaster or dado to dado.

8) **Plastering and Pointing**:

All plastering and pointing shall be measured in square meters unless otherwise described.

Net are of surface plastered shall be measured. No deductions will be made for ends of joints, beams, posts, etc., and opening not exceeding 0.5 Sq.mtr. each and no additions shall be made neither for reveals, jambs, soffits, sills, etc. of these openings nor for finishing the plaster around openings, ends, of joists, beam and posts, etc.

Full deductions will be made for door, window and ventilator from each side with adding jambs for door, window and ventilator.

9) **Painting, White Washing, Colour Washing and Distempering**:

All painting work shall be measured in square meters.

Net are of surface painted shall be measured. No deductions will be made for unpainted surfaces of ends of joists, beams, posts etc., and opening not exceeding 0.5 sq.mtr. each and no additions shall be made for reveals, jambs, soffits, sills, etc., of these openings.

Full deductions will be made for door, window and ventilator from each side with adding jambs for door, window and ventilator.

No coefficient will be considered for painting over sponge finished or sand faced plaster. The following multiplying factors for obtaining equivalent areas shall be adopted.

No.	Description of works	How measured	Multiplying Factor
a)	Wood paneled framed ledged, braces and battened.	Measured flat (not girthed) including frame, edges, chawkats, cleats, etc., shall be deemed to be included in the item.	1 1/8 (for each side).
b)	Wood flush part paneled and part.	-- do – glazed or gauzed.	1 (for each side).
c)	Fully glazed or gauzed or glazed louvered ventilators / window / door.	-- do --	¼ (for each side).
d)	Fully venetioned of louvered (not with glazing).	-- do --	1 ½ (for each side).
e)	Weather boarding.	Measured flat (not girthed supporting frame work shall not be measured separately).	1 1/8 (for each side).
f)	Trellis (or Jaffri) work one way or two ways.	Measured flat overall, no deduction shall be made for opening (supporting members shall not be measured separately)	1 (for each side).
g)	Guard bars, balustrades, gratings, grille railings, grille partitions, etc.	--- do ---	1 (for painting all over).
h)	M.S. gates & open palisades fencing, door including standards, braces, rails, stays, etc.	See note below	1 (for painting over all).

i)	Steel rolling / alligator type shutters.	Measured flat over jambs, guides, bottoms, rails and locking arrangement etc. shall be deemed to be included in the item.	1 ¼ (for each side).
j)	Carved or enriched work.	Measured flat.	2 (for each side).
k)	Fully glazed or gauzed steel windows or partitions.	Measured flat.	1 ¼ (for all over).

Note :

The height shall be taken from the bottom of the lowest rail, if the palisades do not go below it (or from the lower end of the palisades, if they project below the lowest rail) up to the top of the palisades, but not up to the top of the standards, if they are higher than the palisades. Similarly, for the gates, depth of roller shall not be considered while measuring the height.

Area painted over sand cement plaster, sponge finished / sand faced plaster / rough cast plaster area painted without considering any coefficient for painting over sand faced plaster

SECTION – C: WORKMANSHIP

PLAIN & REINFORCED CEMENT CONCRETE

A) **VOLUMETRIC BASIS**: -

General : Except where they are varied by the requirements of this specification due provision of Indian Standard Specification IS-456-1964 for plain and reinforced concrete and IS-432 part I and II for Mild and Medium Tensile steel Bars and hard drawn steel wire for concrete reinforcement and any other relevant ISS applicable together with the latest amendments shall be held to be incorporated this specifications. It shall be intent of these specifications to ensure that all concrete placed at various location of the job should be durable, strong enough to carry design, loads, it should wear well and practically be impervious to water. It should be free from such defects as shrinkage, cracking and honey-combing.

Proportioning the Mix :

In ordinary concrete, excluding controlled concrete, proportions of cement to fine and coarse aggregate shall be as specified in the respective items and shall be accurately measured as in table "A" below. These proportions are based on assumption that the aggregates are dry. If aggregates are moist allowance shall be made for bulking in accordance with IS:2386/-. Allowance shall also be made for surface water present in aggregate when computing water contents. Surface water present shall be determined by one of the field methods described in IS:2386/- (Part III). In the absence of exact data, the amount of surface water may estimate by the value given in table "B" below (Table "A" and "B" please see on page nos.124 & 125).

Mixing :

Concrete of 1:2:4 or richer mix shall be mixed in an approved mechanical mixer. The mixer and mixing platform shall be suitably protected from wind and rain. Aggregates shall be accurately measured out in boxes and mixed dry along with cement, water shall be then added in measured quantity and mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and in consistency but in no case shall he mixing be done for less than 2 minutes.

When hand mixing is permitted with the approval of the Architect it shall be carried out on water-tight mixing platform and care shall be taken to ensure that mixing is continued until mass is uniform in colour and consistency.

Consistency :
Quantity of water for making reinforced concrete shall be sufficient so as to ensure that concrete shall surround and properly grip all the reinforcement. The best consistency shall be that, which will flow sluggishly without flattening out and without separation of

coarse aggregates from the mortar. The degree of plasticity shall depend on the nature of work and atmospheric temperature and whether the concrete is vibrated or hand compacted. The slumps shown in table "C" obtained by standard slump test carried out in accordance with the procedure laid down in IS:119-1959 shall be adopted for different types of work.

Admixtures :
The usage of admixtures is allowed only if approved by the structural consultant and his decision in this regard shall be final.

Transportation:

Concrete shall be conveyed from the place of mixing to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of any of the ingredients. If segregation does occur during transport, the concrete shall remix before being placed. In no case, more than 30 minutes shall elapse between mixing the consolidation in its position.

Placing and Compacting :

Concrete shall be placed in layers of suitable thickness or in strips and compacted before initial setting commences and should not be subsequently disturbed. Method of placing shall be such as to preclude segregation and as far as practicable the placing shall be continuous. Special care shall be taken in accordance with IS:456 while laying concrete under extreme weather.

Concrete shall be thoroughly compacted during the operation of placing and thoroughly working around the reinforcement, embedded fixtures and spaded against corners of the form work and by punning, rodding, mechanically vibrating or by any other approved means. In addition, form work shall be tapped lightly by using wooden mallet at the pouring head. The number and type of vibrator to be used shall be subject to the approval of the Architects and in general immersion type vibrators shall be used. External vibrators shall also be used whenever directed.

The intensity and duration (of vibration shall be sufficient to cause complete settlement and compaction without any stratification of successive layers or separation of ingredients or formation of laitance. Vibrator shall be inserted vertically in the concrete at points not more than 45 cm. apart and withdrawn very slowly when air bubbles no longer come on the surface. Over vibration or vibration of very wet mixes is harmful and should be avoided. Care shall be taken to utilize the vibrator only to compact the concrete and not to spread it, sufficient number of reserve vibrator in good working condition shall be kept on hand at all times, so as to ensure that there is no slackening or interruption in compacting.

Construction Joints :

Concreting shall be carried out end to end continuously as far as possible and when construction joints are totally unavoidable, it shall be located in a predetermined position approved by the Architect. The joints shall be kept at places where the shear force is the minimum and these shall be straight and at right angles to the direction of main reinforcement. When the work has to be resumed, on a surface which has hardened, such surface shall be roughened. It shall be swept clean, thoroughly wetted and covered with a 13 mm. layer of mortar composed of cement and sand in the same ration as the cement concrete mix. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before the placing of the concrete.

Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the
Wet surface with wire or bristle brushes, care being taken to avoid dislodgment of particles of aggregate. The surface shall then be coated with neat cement grout. In horizontal joints the first layer of concrete to be placed on this surface shall not exceed 15 cm. thickness and shall be well rammed against old work, particular attention being paid to corners.

Expansion Joint:
Expansion joint shall be provided where required as shown on the drawings or as directed by the Architect / Consultant. The joints shall be filled by the approved quality filler.

Curing :

Concrete shall be carefully protected during first stage of hardening from harmful effects of excessive heat, drying winds, rain or running water. It shall be covered with a layer of sacking, sand canvas, hessian, or similar absorbent materials and kept constantly, wet for ten days from the date of placing of concrete. Alternatively, the concrete being thoroughly wetted and covered by layer of approved water-proof material which should be kept in contact with it for seven days.

Form Work :

The form work shall conform to the shape, lines and dimensions as shown on the plans and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete and shall be sufficiently watertight to prevent loss of cement slurry from the concrete. Form work or centering shall be constructed of steel or timber and adequately designed to support the full weight of wet concrete without deflection and retain its form during laying, ramming and setting of concrete. Timber used shall be properly seasoned so as to prevent deformation when wetted.

All props shall be straight and of full height and no joints shall be allowed. Props shall be braced with thin bamboos or wooden battens and where additional staging is necessary, extra care shall be taken to use bigger diameters props with bracing at 4 or 5 levels. All props shall be supported on sole plates and double wedges. At the time of removing props these wedges shall be gently eased and not knocked out.

All rubbish, chippings, shavings and saw dust shall be removed from the interior of the forms before the concrete is placed and the form work in contact with the concrete shall be cleaned and thoroughly wetter or treated with nonstaining mineral oil or any other approved materials is kept out of contact with the reinforcement.

All form work shall be removed without shock or vibration and shall be eased off carefully in order to allow the structure to take up its load gradually. Forms shall not be disturbed until concrete has adequately hardened to take up superimposed load coming on it and in no circumstances shall forms be struck until the concrete may be subjected at the time of striking.

In the normal circumstances (generally where temperatures are above 21 degrees centigrade) and where ordinary cement is used, forms may be struck after expiry of following periods :

a)	Walls, Columns and Vertical sides of beam}	48 hours as may be directlyby the Architect
b)	Bottom of slab up to 4.5 m. span.	7 days.
c)	Bottom of slab up to 4.5 m. span. bottom of beam and arch rib up to 6 m. span.	14 days.
d)	Bottom of beams and arch rib over 6 m. span.	21 days.

However, this period may be increased or decreased at the discretion of Architects. Special care shall be taken while striking the centering of cantilevered slab canopies, portal frames, folded plate construction and period of striking centering shall be as determined by the Architect.

If directed, form shall be given an upward camber to ensure that the beams do not have any sag. Surface that becomes exposed on removal of forms shall be carefully examined and any fins, burrs, projections etc., that are detected shall be removed. Any honeycombing of minor nature shall be finished neatly with cement mortar 1:2.

Any work showing signs of damage through premature or careless removal of centering or shuttering, shall be reconstructed by the contractor at his own cost.

Strength :

Concrete mixed in the proportion desired shall have compressive strength after placing, not less than the following:

No	Concrete Mix.	Minimum compressive strength @ 7 days	Minimum compressive strength @ 28 days
1	1:1:2	160 Kg. / Sq.mtr. (2250 Lbs. / Sq. inch).	250 Kg. / Sq.mtr. (3500 Lbs. / Sq. inch).
2	1:1½:3	132 Kg. / Sq.mtr. (1875 Lbs. / Sq. inch).	200 Kg. / Sq.mtr. (2850 Lbs. / Sq. inch).
3	1:2:4	106 Kg. / Sq.mtr. (1500 Lbs. / Sq. inch).	150 Kg. / Sq.mtr. (2250 Lbs. / Sq. inch).

Tests :

Tests on concrete shall be carried out in accordance with IS-456/- and any other is applicable. The frequency of work test shall be at such intervals as ordered by the Architect and subject to that every 150 cu.m. of concrete placed or part thereof and for a day's concrete exceeding 30 cu.m. a batch of 6 cubes shall be made for every sample and 3 of them tested after 7 days and the remaining 3 cubes shall be tested after 28 days. The criteria for acceptance of a concrete as confirming to a specified proportion / grade of concrete shall be in accordance with IS:456 and the Contractor shall entirely re-do the rejected work at his own cost. Strength of 28 days shall alone be considered for acceptance.
The Contractor shall arrange to carry out the tests in accordance with the relevant Indian Standards Specifications in an approved laboratory and the test reports in original be submitted to Architect. The entire cost of testing shall be borne by the Contractor.

Steel Reinforcement :

Reinforcement shall be accurately fabricated, placed and adequately maintained in position as shown on the drawings or as directed by the Architect. All finished bars shall be free from cracks, surface flaws, laminations, jagged and imperfect edges. Cement mortar blocks shall be used to give requisite cover as shown be firmly tied with binding wire of 16 to 18 gauge. Reinforcement shall be bent in accordance with the procedure stipulated in IS:25021963 and will not be straightened in a manner which will injure the material.

All reinforcement shall immediately before placing in concrete be thoroughly cleaned of loose mill scale, loose rust, oil and grease or other deleterious matter that would destroy or reduce bond.

Reinforcement in reinforced concrete members shall not be connected by welding or coupling except in accordance with relevant ISS and with the previous approval of the

Architect. Overlaps and joints shall be staggered and located at points, along the spans where neither shear nor bending moment is maximum.

Cover :

Reinforcement shall have cover as shown on the R.C.C. drawings and where not specified the thickness of cover shall be as follows. Cement mortar blocks in C.M. 1:1 shall be used for making cover blocks.

a) At each end of reinforcing bar not less than 25 mm. not less than twice the diameter of such rod or bar.
b) For a longitudinal reinforcing bar in a column not less than the diameter of such rod or bar. In the case of columns of minimum of 20 mm. or under whose reinforcing bars do not exceed 13 mm. the cover of 25 mm. may be used.
c) For longitudinal reinforcing bar in a column not less than 25 mm. not less than diameter of such rod or bar.
d) For tensile, compressive, shear or other reinforcement in a slab not less than 13 mm. nor less than diameter of such reinforcement, and
e) For ant other reinforcement not less than 13 mm. not less than the diameter of such reinforcement.

A) **WEIGH-BATCHING BASIS i.e. (DESIGN MIX CONCRETE):**

Workmanship of Design Mix Concrete shall be carried out in accordance with I.S:456 – 2000 and any other I.S. Code is applicable.

TABLE – A

No	Nominal Mix.	Quantity of aggregates required per 50 kgs of cement. Fine Cu.m.	Coarse Cu.m.	Quantity of water required per 50 kgs of cement. Vibrated	Un-vibrated (For dry aggregate)
1	1:1:2	0.035 (1.2 C.ft.)	0.070 (2.4 C.ft.)	22 lit. (4.8 Gal.)	27 lit. (6 Gal.)
2	1:1½:.3	0.052 (1.8 C.ft.)	0.106 (3.6 C.ft.)	23 lit. (5 Gal.)	30 lit. (6 Gal.)
3	1:2:4	0.070 (2.4 C.ft.)	0.138 (4.8 C.ft.)	27 lit. (6 Gal.)	32 lit. (7 Gal.)
4	1:3:6	0.105 (3.6 C.ft.)	0.210 (7.2 C.ft.)	28 lit. (6.25 Gal.)	34 lit. (7.5 Gal.)
5	1:4:8	0.150 (4.8 C.ft.)	0.280 (9.6 C.ft.)	-- --	45 lit. (10 Gal.)

TABLE – B

No	Aggregate	Approx. quantity of surface water in Lit / Cu.m.
1	Very wet sand.	120
2	Moderately wet sand.	80
3	Moist sand.	40
4	Moist gravel or crushed sock. Coarser the aggregate, lesser the water will carry.	20 to 40

TABLE – C

No.	Type of Work	SLUMPS	
		When vibrated	When not vibrated
1.	Mass concrete in R.C.C. foundation footing	s2.5 cms. (1")	5 cms. (2")
2.	Beams, slabs, columns with sim reinforcement.	b2.5 cms. to 5 cms. (1" to 2")	5 cms. to 10 cms. (2" to 4")
3.	Thin sections with congested reinforcement	. 5 cms. to 10 cms. (2" to 4")	10 cms. to 15 cms. (4" to 6")

Note: Should conditions governing slump and workability changed pointing to advisability of an increased slump, this shall only be done by decreasing the amount of aggregate and not by increasing the amount of water.

B) **WEIGH-BATCHING BASIS i.e. (DESIGN MIX CONCRETE)**:-

Workmanship for design mix concrete shall be carried out in accordance with I.S. 456-2000 and any other I.S. code is applicable.

BRICK AND STONE MASONRY

General :

All brick work should be carried out as shown on the drawings with setbacks, projections, cuttings, toothings, etc. Wherever the proportion of cement mortar has not been specifically mentioned, cement mortar in the proportion of 1:6 shall be used. Flat bricks arches shall be provided wherever required without any extra cost. Brick work shall be kept wet while in progress, till mortar has properly set. On holidays or when work is topped, top of all unfinished masonry shall be kept wet. Should the mortar become dry, white or powdery, for want of curing work shall be pulled down and rebuilt at the Contractor's expenses.

Brick Work 1st Class:

Bricks shall be thoroughly cleaned, well wetted and soaked for at least twelve hours in fresh water before being used on the work. Bricks shall be of locally, available best quality.

English bond shall be used throughout in walling. A good bond shall be maintained throughout the work, both laterally and transversely. In walling, the courses shall be kept perfectly horizontal and in plumb with the frogs facing upwards. Vertical joints shall not exceed 10 mm. thickness and shall be full of mortar. No broken bricks shall be used except as closers. After day's work all joints shall be raked to 12 mm. depth to provide for proper key to plastering.

Mortar used shall be as specified in respective items and every third course of brick work shall be flushed with mortar grout.

Whole of the masonry work shall be brought up at one uniform level throughout the structure; but where breaks are unavoidable, joints shall be made in good long steps. All junctions of walls and cross walls shall be carefully bounded into the main walls. The rate of laying masonry may be up to a height of 60 cm. per day if cement mortar is used and 45 cm. per day if lime mortar is used. Greater heights may be built only if permitted by the Architect.

During rains, the work shall be carefully covered to prevent mortar from being washed away. Should any mortar or cement be washed away, the works shall be removed and rebuilt at the Contractor's expenses.

Bricks Work 2nd Class:
Shall be similar to 1st class brick work except that 2nd class bricks shall be used and joints shall be 10 mm. t0 12 mm. thick.

Half Brick Masonry :

Shall be set in cement mortar as specified. Hoop iron bands of 2.5 cm. x 0.16 (1" x 1/16") shall be embedded in every fourth course with thick mortar band or 2 Nos. 6 mm. (1/4") dia. bars shall be used in every sixth course otherwise as specified under item.

RUBBLE MASONRY

General :
Stones shall be of the kind specified in the item and shall be from an approved quarry. Stones shall be well wetted before laying in position. The mortar shall be as specified in the item. Face stone shall not be less than in breadth than in height, it shall also tail into the work more than its height. Jambs of doors, windows and openings shall be formed with quoins. In case of battered walls, the courses on battered surface shall be at right angle to the batter.

Through stones or headers shall be laid in every course at a distance not exceeding 2 meters part and shall be staggered. They shall be in one piece for walls up to 1.5-meter width and shall be lap jointed in case of wall having thickness more than half meter. The face area of each header shall not be less than 0.50 sqm. 1:2:4 cement concrete may also be allowed where good length headers are not available. Headers shall be marked with oil paint for ready identification.

Height of quoins shall be same as that of the course. Length of quoins shall be 0.50 m. and shall be laid header and stretcher alternatively. Faces of quoins shall be fair dressed. No quoins stones shall be less than 0.30 cum. In content. Joints of masonry shall be raked out and unless otherwise stated, shall be raised cement pointed by using cement mortar 1:1 to all exposed surfaces. All masonry work shall be well watered for a period of seven days. a) **Coursed**

Rubble Masonry – First Sort :

Height of course shall not be less than 15 cm. and all courses shall be of uniform height. All stones in the course shall be of same height. In no case height of course shall be more than any of the course below it. Bed and sides shall be hammer or chisel dressed back from the face 75 mm. and 35 mm. respectively.

Faces of stones shall be hammer dressed and bushing shall not be more than 35 mm. Thickness of joints shall not be more than 10 mm. Stones shall break joints at least half the height of the course. Work on interior face shall be precisely the same, as on exterior face.

Quoins shall be at least 0.5 m. long laid square on their beds and shall be fair dressed to a depth of at least 10 cm.

b) Uncoursed Rubble Masonry :

Stones shall be hammer dressed. Nearly fifty per cent of stones shall not be less than 0.30 cum. in content each, and twenty-five per cent of stone shall tail back in masonry by 40 cm. or more. Stones shall be so arranged as to break joints as much as possible.

Long vertical joints shall be carefully avoided. Thickness of joints shall in no case exceed 12 mm.

Pillar offsets shall be properly dressed with hammer or chisel to form proper angle. Stones used for the backing shall be of fairly large size.

c) Random Rubble Masonry – First Sort :

Stones shall be roughly chisel dressed. They shall be solidly bedded in mortar. Height of stone shall not be more than width of face or length of tail. Stones shall be of equal size and so arranged as to break joints as much as possible, avoiding long lines of horizontal or vertical joints. Quoins shall be same as described in Coursed Rubble Masonry – 1st Sort. All stones shall be carefully fitted. Thickness of face joint shall be not exceeded 25 mm. Edges of stones shall be chisel dressed for fitting in position properly.

WOOD WORK

Timber used shall conform to specifications described under Materials, Doors, Windows, Ventilators, walls, Paneling, False Ceiling, etc., shall be in accordance with Architect's drawing in every detail and all joiner's work shall be accurately set out, framed and finished in a proper workman-like manner, frames of doors, windows and ventilators etc. and shutter styles and rails shall be best solid teak of quality specified in the schedule of quantities. The scantlings shall be accurately planed smooth, rebates, rounding and mouldings shall be made as shown on the drawings, patching or plugging of any kind shall not be allowed. Joints shall be simple, neat and strong. Framed joints shall be coated with suitable adhesive like glue or synthetic resin before the frames are put together. All mortice and tenon joints shall be fit and fully and accurately without wedging on filling. The joints shall be pinned with hard wood or bamboo pins of 10 mm. to 12 mm. dia. or rust resisting star shaped metal pins 8 mm. after the frames are put together and pressed in position by means of press. The frames are put together and pressed in progress of work by suitable boxing. All portions of timber abutting against or embedded in masonry or concrete shall be treated against termites by giving a coat of any approved wood preservative.

Unless otherwise specified all doors, frames shall have six M.S. flat holdfasts and window frames shall have four holdfasts shall be provided to the ventilators, if directed. Size of holdfasts shall be 30 mm. x 40 mm. x 6 mm. M.S. flat bent to shape worth fish tail end and it shall be fixed to frame with sufficient number of screws as directed. When

door / window frames are to be fixed to R.C.C. column or R.C.C. wall, holdfasts shall be substituted by suitable arrangements such as coach crews, rawl bolts etc., to secure frames to R.C.C. column or R.C.C. wall as directed by the Architect.

Frames and shutter shall not be painted or erected before being approved by Architect.

Panelled Shutter :

Panels shall be of pattern and size as shown on the drawings or as directed by Architect. Solid teak wood panels shall be in one piece wherever possible. Where two or more pieces are permitted, they shall be of equal width. Panels shall be framed into grooves made in styles and rails to the full depth of groove and faces shall be closely fitted to sides of groove.

Where panels specified are block board, it shall be solid core with teak internal lipping and of approved make.

Partly paneled and partly glazed shutter shall be similar to paneled shutters except that such parts as are directed shall be glazed with plain or ground glass as specified. Styles and rails shall be rebated 12 mm. to receive glass. Sash bars shall be moulded and rebated and mitered on sides to receive the glass which shall be fixed with putty and beads

Hardware Fittings :

Unless otherwise specified all hardware, fittings and fixtures shall be supplied by the employer free of charge. However, the cost of fixing fittings shall be included in the rate quoted. The fixing shall be done in the best workman-like manner in accordance with the manufactures specifications. The Contractor shall be held responsible for working of all moving parts dependent on proper fixing. He will also be responsible for any breakage due to negligence during fixing or lack of protection before the building is handed over. The Contractor shall also take delivery of all hardware fittings etc., as and when supplied and arrange for safe storage etc.
Hardware required for fixing false ceiling, wall paneling etc., shall be arranged by the Contractor at his cost. Apart from the hardware fittings required for the joinery items, the Contractor shall have to fix all other items of hardware fittings to be supplied by the employer viz. coat / picture hooks, numerical, letters to denote buildings, hanging rods etc., as directed by the Architects.

Painting and polishing of wood work shall be as per specifications under respective heads.

Flush Doors :

All flush doors shall be solid core unless otherwise specified. It shall conform to the relevant specifications of I.S. 2202 and shall be obtained from approved manufactures. The finished thickness of the shutter shall be mentioned in the items. Face veneers shall be of the pattern and colour approved by the Architect and an approved sample shall be deposited with the Architect for reference.

The solid core shall be wood laminae prepared from battens of well-seasoned and treated good quality wood having straight grains. The battens shall be of uniform size of about 2.5 cm. width. Theses shall be properly glued and machine pressed together, with grains of each piece reversed from that of adjoining one. The longitudinal joints of the battens shall be staggered and no piece shall be less than 50 cm. in length. Alternatively, the core shall be of solid teak particle board. Edges of the core shall be lipped internally with 1st Class teak wood battens of 4 cm. (1.5”) minimum depth, glued and machine pressed along with the core.

The core surface shall then have two or three veneers firmly glued on each face. The first veneer (called cross band) shall be laid with its grains at right angles to those of the core and the second and the third veneers with their grains parallel to those of the core. The under veneers shall be of good quality, durable and well-seasoned wood. The face veneers shall be of minimum 1 mm. thickness and of well-matched and seasoned 1st class teak, laid along with grains of the core battens. The combined thickness of all the veneers on each face shall not be less than 4 mm. Thermosetting synthetic resin conforming to I.S. 303 or moisture-proof plywood grade MPF.I. shall be used in manufacture.
In addition to internal lipping all doors shall have external lipping all round.

STEEL DOORS, WINDOWS, VENTILATORS, M.S. GRILLES ETC.

Steel used in the manufacture of rolled steel sections shall not have more than 0.060 per cent of Sulphur and 0.065 per cent of phosphorus. The carbon content shall not exceed 0.30 per cent and shall be of weldable quality. In all other respects, the rolled steel sections shall conform to I.S. 226-1955 and I.S. 1977-1962.

Frames shall be square and flat. Both the fixed and openable frames shall be constructed of sections which have been cut to length, mitred and electrically welded at corners. Sub-dividing bar units shall be tenoned and rivetted into the frames. All frames shall have the corners welded to a true right angle and welds shall be neatly cleaned off. Couplings, mouldings and weather bar shall be provided as directed by the Architects.

Outer frames shall be provided with fixing holes centrally in the web of the sections and fixing screws and lugs shall be used for fixing the frame to masonry. Mastic cement shall be used for making the joints watertight.

Hinges shall be strong projecting type. If directed friction type hinges shall be used in which case windows shall not be fitted with peg stays.

Projecting type hinged shutter shall be fitted with bronze or brass peg stays, 30 cm. long with peg and brackets welded / riveted to the frame or as sated under item.

All windows shall be provided with handles of brass or bronze or otherwise as stated under them.

Top hung ventilators shall be fixed with plain hinges rivetted / welded to the fixed frame. A brass or bronze peg stay 30 cm. long as in windows shall be provided or as stated under item.

Centre hung ventilators shall be hung on two pairs of brass or leaded tin bronze cup pivots rivetted to the inner and outer frames of the ventilators to permit the ventilators to swing through an angle of approximately 85. The opening position of the ventilator shall be so balanced to keep it open at any desired angle under normal weather conditions. A bronze spring catch shall be fitted in the center of the top bar of the ventilator for the operation of the ventilator. This spring catch shall be secured to the frame with brass screws and shall close into a mild steel malleable iron catch plate rivetted or welded to outside of the outer ventilator frame bar. A brass cord pulley wheel in mild steel or malleable iron brackets shall be provided along with card eye.

The windows and ventilators shall be painted. All the steel surfaces shall be thoroughly cleaned free of rust, scale or dirt and mill scale by picking or phosphating and before erection painted with one coat of approved primer and after erection painted with two finishing coats of synthetic enamel paint of approved shade and quality.

Glazing of specified thickness shall be provided on the outside of frames and unless otherwise specified, metal beading of approved shape, and section shall be used for fixing glasses. Special metal sash putty of approved make shall be used, if directed.

Aluminum Doors, Windows, Ventilators & Partitions etc.:

These shall be obtained from approved and established manufactures and shall be of Aluminum alloy conforming to I.S. 733 and sections shall generally conform to I.S. 1948. Theses shall be fabricated as per the details drawings, Frames for windows, ventilators etc., shall be square and flat. Both fixed and openable frames shall be constructed of section which have been cut to length, mitred and welded at corners. Sub-dividing bars shall be tenoned and rivetted into the frames. All frames shall have corners welded to a true right angle. For side hung shutters, hinges shall normally be of projecting type made of Aluminum alloy and rivetted / welded to frames. Handles, peg stays etc., or approved quality Aluminum or its alloy conforming to IS Specifications.

All types of shutters shall be fabricated, supplied and fixed as specified in the IS:1948. The rate shall include supplying and fixing all fittings and fixtures required for proper and safe operation.

The doors shall be fabricated by using standard aluminum alloy extruded sections as specified in IS:1948. The rate shall include supplying and fixing all fittings and fixtures including approved locking arrangement as directed.

All aluminum fabricated work shall be anodized to the British Standard 1616:1961 to give an anodized film of 25 micron.

The Contractor shall take to stack the fabricated frames etc., on site under cover. They shall be handled with care, stacked on edge on level bearers and supported evenly. Before erecting, the frames coming in contact with concrete, masonry, plaster of dissimilar metals shall be coated with a coat of Zinc Chromate conforming to IS:104-1950. The Contractor shall cover all anodized finish work with a thick layer of clear transparent lacquer based on methacrylate or cellulose butyrate to protect the surface from wet cement during installation. This coating shall remove on completion. Before handing over, the aluminum work shall be washed with mild solution of non-alkali soap and water.

Glazing:

Glazing shall be approved especially quality glass of specified thickness and unless otherwise directed it shall be provided the exterior with metal beading.

FLOORING, SKIRTING, DADO AND STONE VENEERING

All flooring, skirting, dado and stone veneering etc., shall be executed strictly as per relevant IS Specification and in workman-like manner.

Indian Patent Stone:

Selection of materials, method of mixing, placing and compacting shall generally conform to the specifications under plain and reinforced cement concrete described earlier. A stiff mix consistent with workability shall be used.

Preparation of Surface:

Before the operation for laying topping is started the surface of base concrete shall be thoroughly cleaned of all dirt, loose particles coked mortar droppings and laitance if any, by scrubbing with coir or steel wire brush. Where the

concrete has hardened so much that roughening of surface by wire brush is not possible, the surface shall have roughened by chipping or hacking at close intervals. The surface shall then be cleaned with water and kept wet for 12 hours and surplus water shall be removed by mopping before the topping is laid.

Laying:

The screed strips shall be fixed over the base concrete dividing it into suitable panels. Before placing the concrete for topping, neat cement slurry shall be thoroughly brushed into the prepared surface of the base concrete just ahead of the finish. Concrete of specified proportion and thickness shall be laid in alternate panels to required level and slope and thoroughly tamped.

Finishing the Surface:

After the concrete has been fully compacted it shall be finished by troweling or floating with neat cement rendering. Finishing operations shall start shortly after the compaction of concrete and the surface shall be troweled three times at intervals so as to produce a uniform and hard surface. The satisfactory resistance of floor to wear depends largely upon the care with troweling is carried out. The time intervals allowed between successive troweling is very important. Immediately after placing cement rendering, only just sufficient troweling shall be done to give a level surface. Excessive troweling in the earlier stages shall be avoided as this tends to bring a layer rich in cement to the surface. Sometime, after the first troweling, the duration depending upon the temperature, atmospheric conditions and the rate of the set of cement used, the surface shall be re-troweled to close any pores in the surface and to bring to surface and to scrape off any excess water in concrete or laitance. No dry cement shall be used directly on the surface to absorb moistures or to stiffen the mix. The final troweling shall be done well before the concrete has become too hard but at such time that considerable pressure is required to make any impression on the surface.

If directed by the Architect, approved mineral pigment shall be added to the rendering to give desired colour and shade to the flooring at no extra cost.

When instead of 1:2:3 or 1:2.5:3.5 mix, 1:2:4 is specified the topping shall be rendered with 1:1 cement mortar with a suitable mineral pigment, if directed, instead of cement only. If specified in the Schedule of Quantities, the flooring shall be machine polished as per the Architect's instructions.

Wherever the patent stone flooring is used as finishing on roof the joints shall be filled with an approved bitumastic filler in workman like manner.

Ironite Topping:

Instead of finishing the top with rendering coat of 1:1 cement mortar, the top shall be finished with 12 mm. thick ironite topping. Unless otherwise specified, one part of ironite and four parts of ordinary cement by weight shall be mixed dry thoroughly. This dry mixture shall be mixed with stone grit 6 mm. (1/4") and down size or as otherwise directed in the ratio of 1:2 by volume and well turned over. Just enough water shall be added to this dry mix and mixed thoroughly well and laid to uniform thickness of 12 mm. and compacted. After initial set has started the surface shall be finished as directed.

Plain and Coloured Cement Tiles, Marble Mosaic and Terrazzo Tiles Flooring:

The tiles shall conform to IS : 1237 having the colour approved the Architect and the rate shall include provision of border tiles and tiles of different colours in pattern if directed. The mosaic topping of lighter shade tiles shall be made

of White Cement with an approved shade pigment and neutral shade shall be of Grey cement with an approved shade pigment. The type of tiles shall be as specified in respective items.
The sub-grade shall be thoroughly wetted after cleaning of all dirt, laitance, and loose material. A bed of lime mortar consisting of one part of lime and two parts of sand shall be laid and properly leveled to an average thickness of 25 mm. and the surface shall be kept slightly rough to form a satisfactory key for tiles. Neat cement paste of honeylike consistency shall be spread over mortar bed, over such area at a time as would accommodate about 20 tiles. Tiles shall be soaked in water for 15 minutes and allowed to dry for the same duration. Tiles shall then be fixed with a thin coat of cement paste on back of each tile and then each tile being gently tapped with a wooden mallet till it is properly bedded and in level with adjoining tiles. Joints shall be fine and as imperceptible as possible.

After tiles have been laid in a room or a day's fixing work is completed, surplus cement grout that may have come out of the joints may be wiped off gently and joints cleaned. A

thin slurry of coloured cement matching to the colour of tiles shall be spread over it and rubbed so as to seal even a thinnest joint between the tiles and make it impervious and the flooring cured for 7 days. The tiles shall be polished and finished according to IS:1443.

Dado, Skirting and Risers:

Tiles shall conform to IS:1237 and shall be of approved design. The tiles shall be fixed near cement grout on a blacking coat consisting of 1:4 cement sand plaster of 15 mm. thick. The top and bottom junctions of tiles shall be rounded off neatly as directed. The joints shall be filled with matching shade coloured cement slurry. The surface shall be kept wet for 7 days and then polished with carborundum stone to obtain smooth surface and fine polish.

Shahabad / Tandur / Kotah / Cuddappa Stone Flooring :
The flooring shall be either with rough stone or machine cut and machine polished as specified in respective items and shall be of specified thickness and of approved quality and size, free from cracks and flakes and shall be uniform in colour with straight edges. The sides of machine cut and machine polished stone shall have perfect right angles and surface smooth. The stone slabs shall be laid and finished as described under plain cement or colour cement tiles on a bedding of 1:2 lime mortar 25 mm. (Average) thickness. The finished stone surface thus laid shall then be polished to the required degree as approved by the Architect.

In Dado, Skirting, Risers etc.:

Stone slabs shall be laid on backing plaster of cement mortar 1:4 of 15 mm. to 20 mm. thick and finished as described under plain and coloured cement tile dado.

Marble mosaic / Terrazzo in situ work in flooring, dado, skirting etc.:

The terrazzo / mosaic finish shall be laid on an under layer of thickness as specified in the respective items. The topping shall consist of a layer of marble chips of selected sizes, colour and design approved by Architect, mixed with cement with desire shade of pigment.

For lighter shade mosaic. terrazzo white cement shall be used and for neutral shade, grey cement shall be used. The proportion of terrazzo mix shall be three parts of cement one part of marble powder by weight. For every part of cement marble powder mix, the proportion of marble aggregate by volume shall be 1.5 parts unless otherwise specified.

The topping shall be mixed and laid in panels as described in IS:2114 and as per decorative designs prepared by Architects. The dividing strips of panels shall be Aluminum or as specified in the Schedule of Quantities. It shall be polished as specified in IS: 2114.

Marble Flooring:

Marble slabs shall be of the best Indian marble of White or other approved colour as specified in the item. They shall be hard, dense, uniform and homogeneous in texture. They shall have even crystalline grain and free from defects and cracks. The surface shall be machine polished to an even and perfectly plane surface and edges machine cut true to square. The rear face shall be rough enough to provide a key for the mortar.

No slab thinner than the specified thickness at its thinnest part. The sizes of the slabs shall be as specified in the respective items.

The slabs shall be paid as described under mosaic tile flooring in every respect.

White Glazed / Ceramic Tiles / Vitrified Tiles in Flooring and Dado:

White Glazed Tiles from an approved manufacturer conforming to IS:777 shall be used. They shall be of specified size and thickness. All specials viz. coves, internal and external angles, corners, beads etc., shall be used wherever directed. Underlayer of specified thickness and mortar of stipulated proportion shall be laid as described in marble mosaic flooring. Tiles shall be washed clean and set in cement grout and each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and I straight lines or to suit the required pattern. After the tiles have been laid, surplus cement grout shall be cleaned off.

The joints shall be cleaned off the grey cement grout with a wire brush or trowel to a depth of 5 mm. (3/16") and all dust and loose mortar removed. Joints shall then be flush pointed with white cement. The floor shall then be kept wet for seven days. After curing, the surface shall be washed with mild hydrochloric acid and clean water. The finished floor shall not sound not sound hollow when tapped with a wooden mallet.

PLASTERING

Scaffolding:

Scaffolding for carrying out plastering work shall be double steel scaffolding having two sets of vertical supports so that the scaffolding is independent of the walls.

Preparation of surface:

All putlog holes in brick work and junction between concrete and brick work shall be properly filled in advance. Joints in brick work shall be racked about 10 mm. if not raked out while constructing brick masonry work and concrete surface hacked to provide the grip to the plaster, if not hacked earlier projecting burns of mortar formed due to gaps at joints in shuttering shall be removed.

The surface shall be scrubbed clean with wire brush / coir brush to removed dirt, dust etc., and the surface thoroughly washed with clean water to remove efflorescence, grease and oil etc., and shall be kept wet for a minimum of six hours before application of plaster.

Neeru Plaster: Cement mortar of specified proportion and thickness shall be prepared in small batches and applied to the wall surface / ceiling. The ensure proper thickness, gauged patches shall be made at 1.5 to 2 m. apart and the surface plastered true to line, level and plumb taking special care to finish jambs of windows, doors, wall returns, corners, junctions etc. A thin layer of neeru shall then be applied and rubbed into surface and finished by means of trowel until the surface is even and smooth. The surface shall be kept moist for seven days and then given a coat of white wash.

Sand-faced Plaster:

The surface shall be prepared as above.

The coat of cement mortar in proportion of 1:4 or as specified, shall be applied uniformly all over the surface to a thickness of 12 mm. and finished true to level and line and keys shall formed on the surface. The surface shall be kept moist till the finishing coat is applied.

The finishing coat shall be applied a day or two after. The proportion of mortar for finishing coat shall be one part of cement and three parts of selected, well graded and washed sand, or as specified under item and it shall be applied in a uniform thickness of 6 mm. (1/4”).

The surface shall be tapped to uniform grained texture by using sponge pads as directed. Curing shall start after 24 hours and the surface kept wet for seven days.

Rough Cast Plaster:

Except for the finishing coat the surface shall be prepared and base coat of plaster applied as under sand-faced plaster. Finishing coat mortar shall be in proportion of one part of cement and one part of specially selected and graded sand and one part of gravel of 3 to 6 mm. size. It shall be flung upon the first coat with large trowel to form an even and decorative coat. The work shall generally conform to clause 16.5 of IS:1661-1960. The thickness of the coat shall be about 12 mm. (1/2”). It shall be cured for seven days.

Rough coat plaster with colour finish:

This finish shall be similar to Rough cast plaster above except a high-grade mineral pigment of approved shade shall be mixed with white cement instead of ordinary grey cement while preparing the mortar.

Water-proofing Treatment :

Unless otherwise specified, the Contractor shall carry out waterproofing treatment of basements, terrace and water retaining structures through reputed firms having specialization in the line and approved by the Architects. The Contractor shall also furnish full details of such treatment to the Architects and provide all information / proof etc., regarding the effectiveness of the treatment when called upon to do so. All such treatment shall have to be guaranteed in the form approved by the Employer for a minimum period of ten years. Any defects / leakages noticed during the guarantee period shall have to be rectified free of cost by the Contractor including reinstating the surface to its original condition and finish.

Water-proofing of sunk portions of floor slabs for baths, W.C. and kitchen mories etc., in residential buildings, unless otherwise specified, shall be done as specified in the schedule and shall generally comprise of :

a) A coat of hot bitumen, min. 6 mm. thick screened with stone grit.
b) Min. 20 mm. thick cement plaster in cement mortar 1:3 with approved water-proofing cement compound as per manufactures specifications. The plaster shall be cured by pounding for seven days.

The rate for the above treatment shall include drying and cleaning surfaces free of dust etc. and wiping with kerosene before application of bitumen. The vertical faces and returns shall also be treated similarly. The actual area treated including vertical faces and returns shall be measured and paid for. The work should be done in such a way that the finished flooring in bath has a minimum slope of 20 to 25 mm.

PAINTING

General:

Wherever scaffolding is necessary, it shall be double scaffolding.

The surface shall be thoroughly brushed free from mortar droppings and foreign matter. All steel work shall be cleaned of loose rust, mill scales etc. so as to expose the original surface. All broken edges, cracks, loose plaster and wavy surface shall be brought up either by patch plaster work or by plaster of paris.

All materials viz., dry distemper, oil bound distemper, oil paint, flat oil paint, synthetic enamel paint, plastic emulsion paint, cement primer, red lead and other primers and metallic paints shall conform to respective I.S. specifications and shall be obtained from approved manufactures. All paints shall be brought on site in sealed thins in ready mixed form and shall be applied direct with the addition of thinner, if recommended by the manufacturers.

White Washing:

White was shall be prepared from lime slaked on spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for 24 hours and shall be screened through clean cloth. Four kg. gum dissolved in hot water shall be added to each cubic meter of the cream (115 gm. per cft.).

Blue shall be added to give required whiteness. The approximate quantity of water to be added in making cream shall be five liters per kg. of lime.

White wash shall be applied in specified coats by using flat brushes or spray pumps. Each coat shall be allowed to dry before next coat is applied. If additional coats than what have been specified, are necessary to obtain uniform and smooth finish, it shall be given at no extra cost.

The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed. If directed by the Architects one coat of chalk and glue shall be applied before application of white / colour wash at no extra cost.

ColourWash:

Colour wash shall be prepared by adding mineral colours not affected by lime to white wash. No colour wash shall be done until a sample of the colour wash to the required tint or shade has been got approved form the Architects. Colour wash shall be applied as specified under white wash. **Dry**

Distemper:
Shade shall be got approved from the Architects before application of distemper.

The surface shall be prepared as specified earlier. A primer coat using approved primer or sizing shall be applied. Distemper prepared as per manufacturer's directions shall be applied and each coat shall be allowed to dry before subsequent coat is applied. The finished surface shall be free form chalking when rubbed, even uniform and shall show not brush marks. If additional coats are necessary, they shall be given at no extra cost.

Oil Bound Distemper:

The surface shall be prepared as specified above. A primer coat of either cement primer or any approved distemper primer shall be applied.

After the primer coat has dried, the surface shall be lightly sand papered and dusted to make to smooth to receive distemper.

Distemper shall be prepared as per the directions of the manufacturer and conforming to shade approved. It shall be applied in specified coats, taking care to allow for drying of each coat before subsequent coats are applied.

Water-proof Cement Paint / Sand-tex matt Paint:

The surface shall be prepared as specified above and thoroughly wetted with clean water before water-proof cement paint is applied.

The paint shall be prepared strictly as per manufacturers specifications and in such quantities as can be used up in an hour of its mixing, as otherwise the mixture will set and thicken, affecting flow and finish.

The paint thus prepared shall be applied on clean and wetted surface with brush or spraying machine. The solution shall be kept stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The completed surface shall be watered after the days work. Number of coats shall be s specified in the item.

Painting – Oil / Enamel / Plastic Emulsion etc.:

Ready mixed oil paint, flat oil paint, plastic emulsion paint, ready mixed synthetic enamel paint, etc., shall be brought in original containers and in sealed tins. If for any reason thinner is necessary, the brand and quantity of thinner recommended by the manufacturer or as instructed by the Architect shall be used. The surface shall be prepared as specified above and a coat of approved primer shall be applied. After 24 hours drying approved or specified quality paint shall be applied evenly and smoothly. A filler putty coating may be given to give a

smooth finish. Each coat shall be allowed to dry out thoroughly and then lightly rubbed down with sand paper and cleaned of dust before the next cost is applied. Number of coats shall be as specified in the item and if the finish of the surface is not uniform, additional coats as required shall be applied to get good and uniform finish at no extra cost. After completion no hair marks from the brush or clogging of paint puddles in the corners of panels, angles or mouldings etc., shall be left on the work. The glass panes, floor etc. shall be cleaned of stains.

When the final coat is applied, if directed, the surface shall be rolled with a roller of if directed, it shall be stippled with a stippling brush.

POLISHING AND VARNISHING

French Polishing:

French spirit polish shall be of an approved make conforming to IS:348. If it has to be prepared on site, the polish shall be made by dissolving 0.7 kg. of best shellac in 4.5 liters of methylated spirit without heating. To obtain required shade pigment may be added and mixed.
Surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted. Knots, if visible, shall be covered with a preparation of red lead and glue. Resinous or loose knots and gaps shall be filled with season timber pieces and make level with rest of the surface. Holes and indentations on surface shall be filled with putty made of whiting and linseed oil. Surface shall be give a coat of filler made of 2.25 kg. of whiting in 1.5 liter of methylated spirit. When it dries, surface shall again be rubbed down perfectly smooth with sand paper and wiped clean.
Piece of clean fine cotton cloth and cotton wool made into shape of pad shall be used to apply polish. The pad shall be moistened with polish and rubbed hard on the surface applying the polish sparingly but uniformly and completely over the entire surface. It shall have allowed to dry and another coat applied in the same way. To give finishing coat, the pad shall be covered with a fresh piece of clean fine cotton cloth, slightly damped with methylated spirit and fubbed lightly and quickly with a circular motion, till the finish surface attains uniform texture and high gloss.

Wax Polishing :

Wax polish shall either be prepared on site or obtained readymade from market. Polish made on the site shall be prepared from a mixture of pure bee's wax, linseed oil, turpentine oil and varnish in the ratio of 2:1.5:1:½ by weight. The bees wax and the boiled linseed oil shall be heated over a slow fire. When the wax is completely dissolved the mixture shall be cooled till it is just warm, and turpentine oil and varnish added to it in the required proportions and the entire mixture is well stirred.
Surface shall be prepared as described under French polishing except that the final rubbing shall be done with sand paper which has been slightly moistened with linseed oil.
Mixture or polish shall be applied evenly, with a clean cloth pad in such a way that no blank patches are left and rubbed continuously for half an hour. When the surface is quite dry a second coat shall be applied in the same manner and rubbed continuously for an hour or until the surface is dry. Final coat shall then be applied and rubbed for two hours or more if necessary, until the surface has assumed a uniform gloss and is quite dry showing no sign of sickness when touched. Gloss of the polish depends on the amount of rubbing, therefore rubbing must be continuous and with uniform pressure and frequent change in direction.

Varnishing :

Surface shall be prepared as described above. After preparation of surface, two coats of clean boiled linseed oil shall be applied at sufficient interval of time. After the linseed oil has dried two coats of varnish obtained from approved manufacturer shall be applied at sufficient interval of time. If the surface fails to produce the required gloss an additional coat shall be applied without any extra cost.

Miscellaneous Items of Work:

The rates quoted by the Contractor for all miscellaneous items of work viz. cooking platforms, mories, built-in cupboards, counters, partitions, railings, electrical meter, switchboard cupboards, etc., shall be for the work as described in the schedule of quantities and as show in detailed drawings and shall be to the entire satisfaction of the Architects.

MATERIAL TESTING

A chart showing the recommended time and quantity scheduled for conducting test on various building materials is given. Please ensure that tests are carried our according to the above guidelines. Contractor's rate should include for necessary expenditure for testing including transport of samples of following tests.

No	Material	Test	Test Procedure	Minimum Quantity	Frequency
1	Sand	a) Silt Content b) Bulking c) Particle size distribution	Field Field Field	20 Cum 20 Cum 40 Cum	20 Cum or part thereof --- Do --- Every 40 Cum required for RCC work.
2	Stone	a) Soft and Deleterious b) Particle size distribution	IS - 2336 Part – II Field	45 Cum.	As required. Every 45 Cum part thereof for RC work. For rest of work as desired.
3	Cement or Concrete RCC	Slump Cube Strength	Field / Field Laboratory	20 Cum slab, beams and connected columns 5 Cum in columns	Once a day or as desired. Every 20 Cum of a day's concrete. Every 5 Cum column concrete.
4	Steel	a) Tensile Strength	IS - 1529	20 tonnes	Every 20 tonnes or part.
		b) Bend Strength	---- Do ----	---- Do ----	---- Do ----
5	Lime	Chemical and Physical properties of lime.	IS - 6932	5 M.T.	10 M.T. or part thereof

6	Bricks	Dimensions Water absorption Efflorescence compressive strength		Designation 100 75) 50) 40,000 35) --- Do --- 100- 40,000 75) 50) 100,000 35)	Every 40,000 or part thereof. Every 100,000 or part thereof one test for source of 40,000 or part thereof. Two tests for 1st lot of 40,000 and one test later for every 40,000 and part thereof.
7	Brick Tiles	Compressive Strength Efflorescence		40,000 40,000	For 40,000 or part. One test per Source.
8	Marble	Moisture absorption	IS – 1124 – 1974	Rs.10,000/-	Rs. 10,000/- or part thereof. (Value)
		Mhos scale hardness	IS – 1706 – 1972	Value	
9	Timber	Moisture	IS – 11215 – 1985	1 Cum.	Every one Cum and part.
10	Aluminum door or window fitting	Thickness of anodic coating.	IS – 5523 – 1969	Rs. 5,000/-	Rs. 10,000/- or part thereof.
11	Ceramic Tiles / Vitrify Tiles / Designer precast Concrete Tiles and interlocking paver block	a) Transverse Strength b) Water Absorption c) Abrasion test	IS – 1237 --- Do --- --- Do ---	200 Tiles --- Do --- --- Do ---	2000 Tiles or part. --- Do --- --- Do ---
12	Flush Door	a) End Immersion b) Knife c) Adhesion	IS – 2207	22 – 65 66 – 100 101 – 180 181 – 300 301 – 500 501 – above	Destructive tests No. of shutters. 1 2 2 3 4 5
13	Tar felt Type-3 Grade - I	Conform to I.S. 1322 – 1970			One Test
14	Pig lead	I.S. 782 – 1978			One Test
15	R.C.C. design mix M-25	All test as per I.S.:456-2000		As per directed	As per directed

Note : The Contractor will have to take necessary material test other than above test as per I.S. code for above material or other than above material, if required and as directed by the Architect / Owner.

SPECIFICATIONS FOR SANITARY, PLUMBINGAND WATER SUPPLY INSTALLATION WORK

SECTION – A - GENERAL

CONTRACT:

The form of Contract shall be according to the printed form "Conditions of Contract". The following Clause shall be considered as an extension and not in limitation of the obligation of the Contractor.

DRAWINGS:

All-important drawings shall be mounted on boards and placed in racks and indexed; no drawings shall be rolled.

DIMENSIONS :

Figured dimensions shall in all cases be accepted in preference to scaled sizes. Large scale details take precedence over small scale drawings. In case of any discrepancies the Contractors shall ask for clarification from the Architect before proceeding with the work.

CONTRACTOR TO INSPECT SITE:

The Contractor should visit and examine the site of work and satisfy himself as to the nature of existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matter affecting the execution of the work. No extra charge made in consequence, if any misunderstanding or incorrect information on any these points or on grounds of insufficient description will be allowed.

SETTING OUT:

The Contractor shall set out the drainage, soil, waste and water pipe lines and other fittings and fixtures in accordance with the plans and instructions of the Architects. The Contractor shall be responsible for the correctness of the above and any inaccuracies are to be rectified at his own expense as stated in Clause of the Conditions of Contract. He will be responsible for taking levels of the site before setting out and putting them on record without extra charge.

WORK PROGRAMME:

The Contractor should not that the work should be executed and completed ahead of the completion of the general building work and the Contractor shall take care to see that no damage or breakage is done to work once it is constructed and finished. The sanitary and water supply work shall be programmed in such a way that it does not hold up the general construction or works of other trades.

In case of non-availability of materials in metric sizes, the nearest sizes in FPS units shall be provided with prior approved of the Architects for which neither extra will be paid nor any rebate shall be recovered.

If directed, materials shall be tested in any approved Testing Laboratory and the Contractor shall produce the test certificate in original to the Architect and entire chares for originals as well as repeated tests shall be borne by the Contractor. If required by the Architects, the Contractor shall arrange to test portions of the work at his own cost in

order to prove their soundness and efficiency. If after any such test the work or portion of work is found, in the opinion of the Architects, to be defective or unsound, the Contractor shall pull down and re-do the same at his own cost. Defective materials shall be removed from the site.

It shall be obligatory for the Contractor to furnish Certificate, if demanded by Architect, from manufacturer or the material supplier, that the work has been carried out by using their material and installed / fixed as per their recommendations.

CEMENT:

Cement shall comply in every respect with the requirement of the latest publication of IS:269 and unless otherwise specified, ordinary Portland Cement shall be used.

The weight of cement in sealed bags shall be considered as 50 kgs. being equivalent to 35 liters (1.2 Cft.) in volumes.

Cement shall be stored in weather-proof shed with raised wooden plank flooring to prevent deterioration by dampness or intrusion by foreign matter.

SAND:

River Sand shall be clean, free from salt, clay, shells vegetable matter and fit for use in the opinion of Architects.

COARSE AGGREGATE:
Coarse Aggregate shall be angular, tough, sharp and well graded stone metal from approved source. It shall be clean and free from any foreign material. If directed the materials shall be washed.

BRICKS:

Bricks shall be locally available and of the approved quality and well burnt, free from cracks, chips, flaws and stones. It shall not absorb water more than 20% of its own weight when dry.

CEMENT MORTAR:

Cement mortar shall be of the proportion specified in the particular item in the Schedule of Quantities. Sand shall be measured in suitable measuring boxes and correct quantity of cement shall be added. The materials are mixed dry on a clean platform. Clean water is then added and mixed thoroughly. It shall be prepared in such quantity as can be readily used up. Mortar which has partially set shall under no circumstances be re-tampered by mixing with additional materials or water.

I. DRAINAGE (INTERNAL AND EXTERNAL)

STONEWARE PIPE AND FITTINGS:

Shall comply IS:651 in every respect and all stoneware pipes, bends, gully traps and sewer traps shall be of the best salt glazed, variety, glazed inside as well as outside, hard, smooth, even, textured, free from fire cracks, blows and blisters. The pipes shall be truly circular in cross section perfectly straight and of standard nominal diameter, length and depth of socket.

TREASURE TROVE:

Should any treasure, fossils, minerals or work of are antiqurial interest be found during excavation or while carrying out the work, the Contractor shall give immediate notice to the Architects of any such discovery and shall make over such finds to the Employer.

ACCESS FOR INSPECTION:

The Contractor shall provide at all times during the progress of the works and the maintenance period, proper, facilities and necessary attendance for inspection or measurement of works by the Architects or their representatives.

WATER SUPPLY:

Water shall be arranged in accordance with the relevant Clause of Special Conditions of Contract.

ELECTRIC SUPPLY:

Electric energy shall be arranged in accordance with the relevant Clause of Special Conditions of Contract.

VOUCHERS:

The Contractor shall furnish to the Architects with vouchers on request to prove that the materials are as specified and to indicate the rates at which the materials are purchased in order to work out the rate analysis of the non-tender items which he may be called upon to carry out.

SECTION – B - WORKS TO COMPLY LOCAL REGULATIONS AND RATE TO INCLUDE:

1) All sanitary installations, water supply and drainage work shall conform to the Local Municipal Bye-Laws and / or rules and regulations of Local Bodies and the work shall be inspected and passed by the various authorities having jurisdiction.

2) The work shall be carried out through a Licensed Plumber.

3) The Contractor shall arrange with the Local Municipal and / or Public Authorities for obtaining water and drainage connections and the Employer will reimburse the permanent connection charges on production of receipts.

4) The Contractor shall obtain all necessary permission forms from the various authorities having jurisdiction and shall make application and file all plans required for obtaining permission and satisfactory completion of the work.

5) The rates quoted shall be for complete items as fixed in position and cover all costs of materials, labour, tools, supervision, cutting of holes, chases, etc., and also for providing, fixing arrangements viz. clamps, brackets, wooden blocks etc. The rates shall also include restoration to original condition of all damage to walls, floors etc., during the process of fixing of sanitary installations, water supply and drainage. All debris of plumber's excavation etc., shall be removed without any extra charge.

6) All C.I. pipes, brackets, C.I. cisterns, G.I. pipe and fixtures, M.S. fixtures, A.C. pipes and fittings shall be painted externally with one coat of approved primer and two coats of enamel / flat oil paint. All painting work shall be carried out to the entire

satisfaction of the Architects. If directed, additional coats of paint shall be applied to get uniform and matching finish without any extra cost.

7) In the interior of the building all pipe whether of Cast Iron lead or G.I. shall be embedded in an approved manner in chases made in walls or floors if required by the Architects. The plumbers shall make necessary holes in the walls, etc., and restorethem to the original condition.

8) All water supply and sanitary fixtures, pipes and pipe fittings, traps etc., which are to be embedded into the concrete or masonry work or other building work shall be placed in position and embedded or concealed at the time of casting concrete or erecting brick work. In case where chasing or cutting of concrete, masonry, or other structural or construction work is unavoidable, the locations of such fittings, pipe lines and traps, etc., shall be marked suitably and the cutting, chasing or disturbing of the construction work shall proceed only after due approval of the Architects.

9) All cutting, chasing and fixing work shall be completed before commencement of any plastering, tiling or finishing work.

10) Unless otherwise specified Galvanised Iron pipes and pipe fittings shall be of medium quality conforming to IS: 1239 and shall be tested if required by the Architects.

11) The Contractor shall responsible for the adequacy and efficiency of the entire plumbing system and if, in his opinion he finds any serious objection to the system shown on the drawing, he shall set forth his objection or his suggestions to ensure adequacy and efficiency of the said system and notify the Architects before proceeding with the work.

12) The work in every respect during its progress and till final acceptance by the Employer, including raw materials delivered to the work site to be incorporated for use in construction of the work by the Contractor shall be under the charge and in the care of and under the responsibility of the Contractor and at his risk. Any loss or damage to such materials or work prior to final acceptance of the work by the Employer shall immediately be replaced by the Contractor at his expense.

SECTION – C -MATERIALS:

1) Materials shall be of best approved quality obtainable and unless otherwise specified they shall conform to the respective Indian Standard Specification.

2) Samples of all material be got approved before placing order and the approved samples shall be deposited with the Architects.

3) In case non-availability of materials in metric sizes, the nearest size in FPS units shall be provided with prior approval of the Architects for which neither extra will be paid nor any rebate shall be recovered.

4) If directed, materials shall be tested in any approved Testing Laboratory and the Contractor shall produce the test certificate in original to the Architect and entire charges for original as well as repeated tests shall be borne by the Contractor. If required by the Architects, the Contractor shall arrange to test portions of the work at his own cost in order to prove their soundness and efficiency.

   If after any such test the work or portion of works is found, in the opinion of the Architects, to be defective or unsound, the Contractor shall pull down and redo the same at his own cost. Defective materials shall be removed from the site.

5) It shall be obligatory for the Contractor to furnish certificate if demanded by Architect, from manufacturer or the material supplier, that the work has been carried out by using their material and installed / fixed as per their recommendations.

TRENCHES FOR S.W PIPE DRAINS:

EXCAVATION :

The trenches for the pipes shall be excavated to lines and levels as directed. The bed of the trench shall be truly and evenly dressed throughout from one change of grade to the next.

The gradient is to be set out by means of boning rods and should the required depth exceeded at any point, the trench shall be refilled by means of lime concrete of proportion 1:2:4 at the Contractor's own expense.

The bed of the trench, if in soft or made up earth, shall be well watered and rammed and depression thus formed shall be made up with sand or other suitable materials as directed by the Architects without any extra cost.

If rock is met with, it shall be removed to 15 cm. below the level of the pipe and the trench refilled with concrete or sand or other suitable material as directed by the Architects without any extra cost.

The rates shall include keeping trenches dry either by bailing out or pumping water, timbering and shoring of sides of excavation if required and directed by the Architects.

The trench width shall be nominal diameter of the pipe plus 38 cm. (15") but it shall not be less than 52 cm. (21").

PROTECTION OF EXISTING SERVICES:

All pipes, water mains, cables, etc., meet with in the course of excavation shall be carefully protected and supported.

REFILLING:

Refilling in trenches for pipes shall be commenced as soon as the joints are tested, approved and haunching is done. The refilling on the top and around the drain shall be done with great care and in such a manner as will obtain the greatest amount of compactness and a solidity possible. For this purpose, the earth shall be laid in regular layers of 15 cm. (6") watered and each layer rammed.

All surplus earth shall be disposed of as directed by the Architects.

CONCRETING:

All pipes shall be laid on bed of 15 cm. (6") concrete with one part of cement, four parts of sand and eight parts of brickbats of 38 mm. (1.5") down gauge or stone metal properly consolidated. Concrete shall be laid to the full width of the trench and also in haunches as per the standard drawings. Or as described under item in Schedule of Quantity.

LAYING AND JOINTING S.W. PIPES :

LAYING :

The pipes shall be carefully laid to the levels and gradients shown on the plans and sections with "Socket Up" the gradient.

JOINTING:

Spun yarn soaked in neat cement wash shall be passed round the joint and inserted in it by means of caulking tool. More skeins of yarn shall be added and well rammed home. Cement mortar with one part of cement and one part of sand shall be slightly moistened and must on no account be soft or sloppy and shall be carefully inserted by hand into the joint. The mortar shall then the punched and caulked into the joint and more cement mortar added until the space of the joint has been filed completely with tightly caulked mortar. The joint shall then be finished off neatly outside the socket at an angle of 45 degree.

CURING :

The joint shall be cured at least for seven days.

TESTING:

All joints shall be tested to a head of two feet of water above the top of the highest pipe between the two manholes. Any joint found leaking or sweating shall be remade or embedded in 15 cm. thick layer of cement concrete (1:2:4) 30 cm. in length and section retested at Contractors own cost.

STONEWARE GULLY TRAPS:

S.W. gully traps of specified sizes and quality as described earlier shall be fixed on 15 cm. thick and 70 cm. square cement concrete 1:4:8 bedding and the gully outlet to the branch drain shall be jointed similar to jointing of S.W. pipes. A brick masonry chamber 30 cm. x 30 cm. internally shall be constructed in half brick masonry with 1:5 cement
mortar and the space between the trap and the wall filled up with cement concrete (1:4:8) and the upper portion of the chamber finished internally with 1:3 cement mortar and finished with neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.

In addition to 15 cm. x 15 cm. C.I. grating, the chamber shall have a C.I. cover with frame 30 cm. (inside) with machined seating faces, fixed on the top of the brick masonry with cement concrete 1:2:4 and rendered smooth. The weight of cover shall not be less than 4.53 kgs. and that of frame 2.72 kgs. The finished top of cover shall be left 4 cm. above the adjoining surface so as to exclude the surface water from entering the gully trap. Or as described under item in Schedule of Quantity.

HUME PIPE DRAINS :

PIPES :

Shall be reinforced and conform to relevant I.S. Specification. They shall be new and perfectly sound, free from cracks, cylindrical, straight and of specified nominal diameter. Each pipe shall have one collar.

TRENCHES AND REFILLING :

Shall be as described under S.W. pipes.
Or as described under item in Schedule of Quantity.

CONCRETING :
No concreting is ordinarily necessary. In cases where the soil is made up or is very soft, concreting may be resorted to as described under "Stoneware pipe fitting" without any extra cost.

LAYING AND JOINTING :
The pipe shall be laid as described under Stoneware pipe and fittings by placing the collar centrally over the joint.

CAST IRON PIPES FOR DRAINAGE:
All drainage lines passing under buildings, floors and roads, in exposed horizontal positions above ground, shall be cast iron pipes. Pipes shall be sand cast conforming to Class "A" IS:1537 or centrifugally spun cast iron Class LA conforming to IS:1536.

	BARREL					
Nominal dia. mm.	Outside dia. mm.	Wall thickness in mm.	Wt. per (approx.) in k	Socket in kgs.	Depth of socket in mm.	Total Wt. 3.66 m. in kgs.
80	98	7.2 (7.9)	14.7 (16)	5.5	84	59 (64)
100	118	7.5 (8.3)	18.6 (20.5)	7.1	88	75 (82)
125	144	7.9 (8.7)	24.7 (26.4)	9.2	91	98 (106)
150	170	8.3 (9.2)	30.1 (33.2)	11.5	94	122 (133)
200	222	9.2 (10.1)	44 (48.1)	16.8	100	178 (193)
250	274	10.0 (11.0)	59.3 (65.0)	22.9	103	240 (261)

Note : Figures in brackets indicate particulars of pipes conforming to Class "A" IS:1537 quality and other particulars remaining the same.

These shall be free from cracks and other flaws. The interior of pipes and fittings shall be clean and smooth and painted inside and outside with Dr. Angus Smith's solution or other approved anti-corrosive paint, if not painted initially by the manufacturer.

The access door fittings shall be of proper design so as not to form any cavities in which filth may accumulate. Doors shall be provided with 3 mm. (1/8") rubber insertion packing and when closed and bolted they shall be watertight.

The joints shall be filled with lead as described under Soil Pipes.

II. SANITARY INSTALLATION:

SANITARY FIXTURES:

INDIAN TYPE W.C. PANS :

The W.C. pan shall be of White Vitreous China, of specified size and pattern. Pan shall be of approved quality and shall bear the mark of the firm manufacturing it. It shall have 10 cm. (4") porcelain trap ("P" or "S" type with effective seal) and 5 cm. (2") vent arm.

ORISSA TYPE PANS:

Shall be from an approved manufactures and traps as specified above.

FIXING :

Pan shall be fixed securely with a cushioning bed in an approved manner taking care that the cushion is uniform and even, without having any hollows between pan and the concrete. The joint between the pan the trap be made with cement mortar 1:1 and shall be leakproof.

Each closet shall be provided with the following accessories and the rate shall be all inclusive.

1) Necessary length of 10 cm.; H.C.I. pipe or lead pipe connecting the pan and plug bend. (The plug bend / tee connection to vertical stack shall be paid under appropriate item).

2) Wherever anti-syphonage pipe connections are required necessary length of lead pipe 6.25 cm. shall be provided.

3) Flushing cistern shall be 10 litres capacity and cast-Iron overhead type with heavy G.I. Chain pull unless otherwise specified. If low down cistern is specified it shall be White Vitreous China cistern of best quality from an approved manufacturer with Chromium plated flush handle. The cistern shall have G.I. overflow pipe of length as per Municipal requirement or as per Architects drawing with mosquito-proof Brass screw cap and C.I. brackets with wall plugs and Brass union and couplings for flush pipe etc. complete unit.

4) 12 mm. PVC water inlet pipe with 12 mm. Brass stop cock.

5) The flush pipe from the cistern shall be of 32 mm. dia. telescopic G.I. pipe or lead pipe or as specified, which shall be connected to the W.C. pan by means of an approved type of joint.

6) Painting : All fittings and fixtures shall be painted with two coats of enamel paint over a coat of primer. Or as described under item in Schedule of Quantity.

EUROPEAN TYPE W.C. :

The closet shall be of White Vitreous China readily flushed, of wash down type and shall be of best quality manufactured by an approved firm, and fixed to the floor by approved means, as described under item in Schedule of Quantity.,

Each closet shall be provided with the following accessories and the rate shall be all inclusive.

1) **Seat** : Heavy black plastic seat of approved quality and seat cover with rubber buffers fixed to the pan with C.P. Brass bar hinge.

2) **Cistern** : Low level flushing tank 10 litres capacity of White Vitreous China cistern of best quality manufactured by an approved firm with C.P. flush handle and C.P. overflow pipe of length as per Municipal requirement or as per Architects drawing with mosquito-proof brass C.P. Cap etc., complete unit including enamelled or C.P. flush pipe and bend.
Or as described under item in Schedule of Quantity.

3) Necessary length of PVC water inlet pipe and 12 mm. dia. C.P. brass stop cock.

4) Necessary length of porcelain or lead or C.I. connecting pipe 10 cm. dia. (plug bend / tee connection to vertical stack shall be paid under appropriate item).

5) Wherever anti-syphonage pipe connections are required, necessary length of lead pipe 6.25 cm. dia. shall be provided.

PAINTING :

All fittings and fixtures shall be painted with two coats of enamel paint over a coat of primer, externally.

LIPPED URINALS:

Shall be flat back or angle urinal of specified dimensions and shall be of White Vitreous China from an approved manufacturer.
They shall be screwed to the wall with coach screws of Chromium Plated Brass on dowel shaped wooden plugs built into the walls or fixed as per manufacturers specification. Each basin should have an outlet with C.P. Brass hinged grating connected to 40 mm. diameter waste pipe through a C.P. bottle trap. When a range of urinals are provided only a straight length of 40 mm. diameter waste pipe and white glazed half round channel with tread platform finished with white glazed tiles complete as per Architects drawings shall be provided. All joints shall be in plumbers wiped solder joint with necessary C.P. Brass sockets and thimble etc.

STALL WALL TYPE URINALS :

Shall be White Vitreous China of approved design and manufacture.

They shall be fixed to the wall as per manufacturer's specification. Each urinal should have an outlet with C.P. Brass hinged grating connected to 40 mm. diameter waste pipe through a C.P. Brass bottle trap. All joints shall be in plumber's wiped solder joint with necessary C.P. Brass sockets and thimble etc.

FLUSHING CISTERN :

These shall be automatic flushing cistern of vitreous China or as specified in the Schedule of Quantities complete with valve less syphon fittings. Cistern shall be supported on brackets of standard pattern and fixed to wooden dowel plugs embedded in the wall with C.P. Brass screws.

ANGLE VALVE :

The cistern shall be fed with 15 mm. (1/2") C.P. Brass inlet tube angle valve of approved make with necessary length of lead inlet pipe complete with C.P. Brass unions unless otherwise specified in the Schedule of Quantities.

The capacity of flushing cistern and size of the flush pipe for the number of urinals shall be as follows :

	Capacity of flushing cistern		Mains		Size of distribution	
Numbers of Urinals	In Litres	In Gallons	In mm.	In inches	In mm.	In inches
1	5	1	--	--	15	1/2
2	10	2	20	3/4	15	1/2
3	10	2	25	1	15	1/2
4	15	3	32	1.25	15	1/2

The main and distribution pipe fittings and clamps shall be of C.P. Brass unless otherwise specified in the Schedule of Quantities. Distribution pipes shall feed the urinals with C.P. brass spreaders of approved make.

PAINTING :

All brackets etc., shall be painted with two coats of enamel paint over a coat of primer.

LAVATORY BASINS:

They shall be of White Vitreous China of best quality manufactured by an approved make and size as specified in the Schedule of Quantities. They shall be supported on a pair of C.I. brackets of approved design.

a) **Fittings**: Each lavatory basin shall be provided with a single cold water C.P. Brass pillar tap of approved design and make, C.P. Brass waste, C.P. Brass chain and rubber plug, C.P. Brass bottle trap of approved quality and design, with C.P. brass stop cock and PVC water inlet pipe of standard length 1/2" dia. complete.

b) **Waste Pipe** : Waste pipe beyond bottle trap shall be measured and paid separately under appropriate item. Where specified, lavatory basins shall be provided with puff pipe with a brass perforated screws cap.

c) **Painting** : All brackets, pipes etc. shall be painted with two coats enamel paint over a coat of primer.

SINKS :

They shall be of White Vitreous China or as specified in the Schedule of Quantities with weir type overflow. The size of sink shall be as specified and shall be of approved make. They shall be supported on a pair of C.I. brackets of approved design.

a) **Fittings** : Each sink shall be provided with 40 mm. (1.5") C.P. Brass waste of approved pattern with C.P. Brass chain and 40 mm. rubber plug and 40 mm. dia. C.P. Brass trap and union which shall be connected to 40 mm.

diameter waste pipe.

Waste pipe beyond the trap shall be measured separately and paid under appropriate item. Where specified sinks shall be provided with puff pipe with a Brass perforated screw item.

b) **Painting** : All fittings, brackets and pipes shall be painted with two coats of enamel paint over a coat of primer.

DRAINAGE BOARD :

Drainage boards of type and size as specified in the Schedule of Quantities shall be provided. These shall be fixed on strong brackets of approved design and where necessary provided with hinges. Brackets shall be painted with two coats of enamel over a coat of primer.

III. TOILET REQUISITES :

MIRRORS :

Mirrors shall be of the best quality, specified size, approved design and make. It shall be mounted on plywood / particle board backing and shall be fixed in position by means of four C.P. Brass screws and cup washers over rubber washers on wooden plugs firmly embedded in the wall. Alternative method for fixing could be by using Brass clamps with C.P. Brass screws. A suitable T.W. cover mould of approved design shall be fixed all round as directed.

GLASS SHELF :

The shelf shall be of glass of approved quality and thickness with edges rounded off. The size of the shelf shall be as specified and shall rest on C.P. Brass brackets which shall be fixed with C.P. Brass screws to wooden plugs, firmly embedded in the wall. The shelf shall have C.P. Brass guard rail all round.

TOWEL RAIL :

Towel rail shall be of C.P. Brass with two C.P. Brass brackets. The size of the rail shall be as specified. The brackets shall be fixed by means of C.P. brass screws to wooden cleats firmly embedded in the wall. Where specified, Aluminum towel rails may be used of approved quality and design.

TOILET PAPER HOLDER :

Toilet paper holder shall be of White vitreous China or as specified. It shall be recessed in wall.

IV. C.I. SOIL, WASTE AND VENT PIPES AND FITTINGS:

C.I. PIPES AND FITTINGS:

Cast Iron Soil, Waste and Vent pipes and fittings shall be of heavy quality conforming to IS:3989 for spun pipes which is preferred to Sand Cast Soil pipes conforming to IS:1729. The standard weights and thickness of pipes are given below and a tolerance up to 4% my however be allowed against these standard weights.

(IS:3989-1967 for centrifugally spun soil pipe)

Nominal dia.		Thickness	Overall weight 1.8 m. length (Six fee	Internal dia. of socket
In mm.	In inches	In mm.	In kgs.	In mm.
50	2	3.5	8.5	73
75	3	3.5	12.7	99
100	4	4.0	19.2	126
150	6	5.0	35.5	179

(IS:1729-1964 for sand cast soil pipes)

Nominal dia.		Thickness	Overall weight 1.8 m. length (Six fee	Internal dia. of socket
In mm.	In inches	In mm.	In kgs.	In mm.
50	2	5	11.41	76
75	3	5	16.52	101
100	4	5	21.67	129
150	6	5	31.92	181

LAYING :

The pipes shall be laid as described in the Schedule of Quantities and as shown on the Architects drawings.

FIXING:

The pipes and fittings shall be fixed to walls by using proper holder bat clamps, if directed. The pipes shall be fixed perfectly vertical or in approved alignment. The spigot end shall about the shoulder of the socket and leave no annular space in between. All soil and waste water pipes shall be carried up above the roof parapet wall and shall have vent cowl.

Connections between main pipe and the branch pipes shall be made by using appropriate branches and bends invariably with access doors for cleaning.

NAHANI OR FLOOR TRAPS:

The traps shall be of self-cleansing, design deep seal type with a minimum seal of 5 cm. (2”). If directed, 25 mm. puff pipe shall be provided. The other specifications for these shall be the same as those for C.I. soil, waste and vent pipes and fittings.

PAINTING : All exposed C.I. pipes and fittings shall be painted externally to match the colour of the surroundings with two coats of flat / enamel paint over a coat of approved primer. If directed, additional coats shall be given at no extra cost.

LEAD PIPE :
All lead pipes shall be hydraulic drawn and of equal substance throughout conforming to IS:404-1962. Weights and wall thickness of pipes shall be as under:

Nominal dia.		Wall thickness	Wt. in Kgs.
In mm.	In inches	In mm.	Per meter.
32	1.1/4	2.6	3.28
40	1.5	2.6	3.95
50	2	2.7	5.07
75	3	2.7	7.48
100	4	2.7	9.88

When not supported on bearers, all led pipe shall be supported by strong lead stacks at least 40 mm. (1.5") wide soldered on to the pipes at suitable intervals.

WIPED SOLDER JOINTS:

All joints of lead pipe shall be wiped solder joints as described below.

The pipe ends to be jointed shall be cleaned with a wire brush and freed from oxide, if any. Chalk shall then be rubbed to kill the greasy nature of lead. After this, plumbers black shall be applied. The length of the joint as given below shall then be marked on the pipe. A fine shaving of lead shall be removed from this length with shave hook. Tallow shall then be smeared over the prepared surface. The molten solder, an alloy composed of three parts of tin and seven parts of seven parts of lead, shall be poured in a thin stream from a ladle moved in an elliptical direction over the joint position including a portion of the soil pipe at each end beyond the mark. When sufficient solder has long continuous movements in one direction only so as to leave a neatly formed elliptical shaped joint. Surplus solder remaining on the joint shall be removed.

The length of the wiped solder joint shall be as follows :

No	Size of pipe		Length of Joint			
			Minimum		Maximum	
	In mm.	In inches	In mm.	In inches	In mm.	In inches
1	15	1/2	60	2.1/4	70	2.3/4
2	20	3/4	65	2.5	70	2.3/4
3	25	1	70	2.3/4	75	3
4	32	1.1/4	70	2.3/4	80	3.1/4
5	40	1.5	70	2.3/4	80	3.1/4

6	50	2	75	3	90	3.5
7	75	3	75	3	90	3.5
8	100	4	80	3.1/4	90	3.5

The joints shall be watertight, airtight and shall be free from tears, burrs, strings, ribbons or droppings.

LEAD PIPE CONNECTION:

The joints between lead pipe and C.I. or stoneware pipe shall be made as follows:
One end of Brass thimble or ferrule shall be slipped into or over the lead pipe and jointed to it by means of a wiped solder joint. The other end of the ferrule shall then be inserted into the socket of the C.I. or stoneware pipe. In case of former the joint shall be made with molten lead (lead caulked) and in case of the latter with cement mortar as in stoneware pipe drains.

The joints between outgo of a W.C. Pan and a lead pipe shall be made as under :

The lead pipe shall be slipped into Brass socket and jointed to it by a wiped solder joint. The outgo of a W.C. pan shall then be inserted into the socket and jointed by using cement mortar as in stoneware pipe drain.

PAINTING:

All exposed lead pipes shall be painted as in H.C.I. pipes and fittings, externally.

ASBESTOS CEMENT PIPES:

Where specified, asbestos cement pipes and fittings may be used for soil, waste and vent pipes and rain water pipes.
Asbestos cement pipes shall be of the best quality conforming to IS:1629-1960.
Pipes shall be of painted as described for C.I. pipes, with two coats of approved quality and shade cement paint.

V. INTERNAL WATER SUPPLY:

G.I. PIPES AND FITTINGS:
The pipes shall be of the class specified in the Schedule of Quantities and shall be of galvanised welded or seamless, screws and socketed and shall conform to IS: 1239. They shall be manufactured by a firm of repute. All fittings shall be malleable iron galvanised fittings of approved best Indian make.

The details of pipes regarding nominal bore thickness and weight are given below.

Approx outside dia.	Nominal Bore		Screwed and Socketed wt. per meter			Screwed and Socketed meter per 1000 kgs.		
In mm.	In mm.	In nearest inch.	Light kgs.	Medium kgs.	Heavy kgs.	Light kgs.	Medium kgs.	Heavy kgs.
10.2	6	1/8	0.364	0.410	0.496	2747	2439	2016
13.5	8	¼	0.521	0.654	0.773	1919	1529	1294
17.2	10	3/8	0.680	0.858	1.03	1470	1166	971
21.3	15	½	0.961	1.23	1.46	1040	813	685

26.9	20	¾	1.42	1.59	1.91	704	629	524
33.7	25	1	2.03	2.46	2.99	493	407	334
42.4	32	1.1/4	2.61	3.17	3.87	383	316	258
48.3	40	1.5	3.29	3.65	4.47	304	274	224
60.3	50	2	4.18	5.17	6.24	239	193	160
76.1	65	2.5	5.92	6.63	8.02	169	151	125
88.9	80	3	6.98	8.64	10.3	143	116	98
101.6	90	3.5	8.92	9.90	11.8	112	101	84.7
114.3	100	4	10.2	12.4	14.7	98	80.6	68.0
139.7	125	5	--	16.7	18.3	--	59.9	54.6
165.1	150	6	--	19.8	21.8	--	50.5	45.9

Note : The above weights are for black pipes and theoretical weights of galvanized pipes are 6% higher.

LAYING AND FIXING:

Where pipes have to be cut or re-threaded, ends shall be carefully filled out so that no obstruction to bore is offered. For internal work all pipes and fittings shall be fixed truly vertical and horizontal, either by means of standard pattern holder-bat clamps keeping the pipes 12 mm. (1/2") clear of the wall everywhere or concealed as directed.

For external work, G.I. pipes and fittings shall be laid in trenches. The width of the trench shall be of minimum width required for the working. The pipes laid underground shall not be less than 60 cm. (2 ft.) from ground level. They shall be painted with hot asphalt and wrapped with Hessian cloth and again painted with two coats of hot asphalt (pipe embedded in masonry / concrete shall be treated similarly). They shall be surrounded with 15 cm. thick sand of approved quality all around. The work of excavation and refilling shall be done as directed.

PAINTING:

All exposed pipes and fittings shall be painted with two coats of approved shade of flat / enamel paint over a coat of approved primer and if directed, additional coat of paint shall be given without any extra cost.

TESTING:

All G.I. pipes and fittings shall be tested in an approved manner to ensure that pipes have proper threads and those proper materials such as white lead and hemp have been used in jointing. All leaky joints must be made leak proof by tightening or redoing at Contractors expenses.

BRASS WATER FITTINGS:

All Brass water fittings shall be of approved quality and design and shall generally comply with the latest I.S. Specifications. They shall be fixed in the pipeline in a workmanlike manner and care shall be taken to see that joints shall be tested in an approved manner to ensure that the joint is leak proof. The defective fittings and the joints shall be repaired or redone / replaced at Contractor expenses.

VI. EXTERNAL WATER SUPPLY:

CAST IRON PIPES AND SPECIALS:

All pipes and special for water supply shall be of cast or spun iron straight with spigot and socket ends and shall conform to the latest edition of the I.S. Specification for Class "B" pipes. Heavier quality pipes and specials shall be used when the water pressure exceeds 122 meters (400 ft.) of head, flanged end pipes may also be used where required and specifically approved.

Details of nominal bore and weights for Class "B" pipes shall be as specified below:

	Barrel				Total weight for one working length in meters			
Nominal dia. meter	Outside dia.	Wall thickness	Wt. per meter (approx.)	Socket weight (approx.)	3.66	4.00	4.88	5.5
In mm.	In mm.	In mm.	In kgs.	In kgs.	In kgs.			
80	98	8.6	17.3	5.5	69	74.5	--	--
100	118	9.0	22.0	7.1	88	95	--	128
125	144	9.5	28.7	9.2	114	124	--	167
150	170	10.0	35.9	11.5	143	125	--	209
200	222	11.0	52.1	16.8	207	255	271	304
250	274	12.0	70.6	22.9	281	305	368	411
300	326	13.0	91.4	29.8	364	395	476	533
350	378	14.0	114.5	37.5	457	495	596	667

Note : Specification and specials shall be coated inside and outside while hot with Dr. Angus Smith's solution or other approved anti-corrosive paint, if not painted initially by the manufacturer.

TRENCHES FOR C.I. PIPES AND SPECIALS:

Trenches shall be excavated as described under "Drainage" for S.W. pipes.

LAYING:
Before laying the pipes, they shall be examined to see that there are no cracks or defects. Subject to the approval of the Architects the damaged portion of the cracked pipe may be cut at a point not less than 15 cm. beyond the visible extremity of the cracks with diamond pointed chisel.

The pipes shall be thoroughly cleaned of all dust and dirt. Special care shall be taken to clean the insider of the sockets and the outside of the spigots before lowering the pipes into the trenches. Holes to receive the sockets shall be scooped out in the trench bed so as to firmly bed the full length of the pipe.

The pipes shall be lowered into the trench by means of suitable pulley blocks, shear-legs, chains, ropes etc. In no case the pipes shall be rolled and dropped into the trench. After lowering the pipes, they shall be arranged to coincide the center line of pipes with the center line of alignment. The spigot of the one pipe shall be carefully centred into the socket of the next pipe and driven to the full distance to the full distance that it can go and pipe line laid to levels required, being kept in position be earth filling, well-watered and rammed at two or more places in its length.

Special shall also be laid in their proper position as stated above. The pipes shall be laid with socket facing the direction of flow of water facing uphill.
Any deviation either in plan or elevation of less than 11.1/4 shall usually be affected by laying the straight pipes round a flat curve of such radius that minimum or lead at the face of the socket shall not be reduced below 12 mm. or the opening between spigot and socket increased beyond 12 mm. at any joint. Deviation of about 2.1/4 can be affected at each joint in this way. At the end of each day's work, the last pipe to be laid shall have its open end securely closed with a wooden plug, to avoid rats and other small animals getting in.

Cement concrete thrust blocks of suitable design shall be provided at 45 to 90-degree bends of the pipes so as to withstand dynamic and static forces likely to be developed due to water running through the pipes. The thrust blocks shall be made after the joints have been caulked with lead and these shall be paid for separately, unless otherwise specified.

LEAD CAULKED JOINTS:

1) Lead for joints: It shall be bluish grey in colour, very soft and malleable, readily melted, free from mixture of zinc or tin.
2) Spun yarn for joints: This shall be of best quality preferably white, it shall be free from dust etc. It shall be soaked into hot coal tar or bitumen and dried before use.
3) Jointing: The spigot shall be carefully centered in the socket by two or three laps of treated spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket, leaving the requisite depth for the lead. The laps of the yarn must be longer than the circumference of the pipe. No making up of the pieces shall be allowed.
4) The leading of the pipes etc., shall be done by means of ropes covered with clay or by using special leading rings. The lead shall be rendered thoroughly fluid and each joint shall be filled in one pouring.
5) Approximate weight of lead and yarn required for joints for various sizes of C.I. pipes and specials shall be as under:

Dia. of pipe		Lead		Yarn		
In mm.	In inches	In kgs.	In lbs.	In kgs.	In lbs.	In ozs.
75	3	1.8	4	0.114	0	4
100	4	3.0	6.5	0.170	0	6
125	5	3.6	8	0.199	0	7
150	6	4.2	9.5	0.227	0	8
180	7	4.8	10.5	0.255	0	9
200	8	5.5	12	0.298	0	10.5
230	9	6.4	14	0.340	0	12
250	10	6.6	14.5	0.397	0	14
300	12	8.0	17.5	0.539	1	3

6) Caulking : After the joints have been run they must be thoroughly caulked until they are perfectly watertight. Caulking of joints will be done after a convenient length has been laid and leaded. The leading rings shall first be removed with a flat chisel and then the joint caulked round three times with caulking tools of increasing thickness and a hammer of 2 to 3 kgs. (4 to 6 lbs) weight. Lead joints shall not be covered till the pipeline has been tested under pressure but the rest of pipeline may be covered to prevent expansion and contraction due to variation in temperature.

7) When it is inconvenient or dangerous to use molten lead for joints, they may be made with lead wool inserted in strings not less than 6 mm. (1/4") thick and thoroughly caulked.

8) Testing : The lead joints shall be tested to a pressure of 7 kgs. per sq.cm. (100 lbs. per sq. inch.) or such head as otherwise, specified after being caulked and should any leakage occur, the leaky joint or joints shall be remade and section retested at Contractor's own expenses, until satisfactory results are obtained.

SLUICE VALVES, FIRE HYDRANTS AND MASONRY CHAMBERS:

1) Sluice Valves: The valve shall be of the specified size and shall be approved quality.

2) The body and cover of the valve shall be of tough, homogeneous cast iron, the spindle of forged bronze, the nut and the valve seats of high grade gun metal and machine-faced. It shall be fitted with a C.I. Wheel or a cap of standard type, marked with a show the direction of turn for opening of the valve. It shall have flanged ends drilled to Indian Standard Specification.

3) The valves shall work easily and smoothly under all conditions and shall be watertight when closed under the working pressure as stipulated as in the relevant I.S.S. unless otherwise specified, valves shall be Class II type as in IS:778:1971.

4) The diameter of the waterway, when the valve is fully opened shall not be less than the diameter of the pipe.

5) Fixing : Fixing of the valve shall be done by means of bolts nuts and 3 mm. (1/8") rubber insertions with the flanges of the spigot and socket tail pieces drilled to the same specifications. The tail pieces shall be jointed to the pipe line by means of lead caulked joints.

6) **APPURTENANCE**

The other appurtenances of the pipeline are mentioned below:

1) Air valves: These are placed at every summit in the pipe line to permit the escape of air when the main is filled, and afterwards air, if any is carried into the main (they are also placed on long stretches of nearly level main).

2) Scour valves: These are placed at the bottom of all depressions for emptying the main or letting out sediment.

3) Reflux valves: These are fixed on the ascending parts of the main which open in the direction of flow, but automatically close if a burst occurs and the water flows back. They diminish damage done by the escape of water at a burst.

4) Safety or relief valves: these are fixed at the downstream ends of long lengths of mains or where water hammer may take place so as to reduce to the normal any excessive pressure that may occur.

5) Fire hydrants: These shall be of approved design and be fixed as shown in the drawings and as per Architects direction. The cost of hydrant shall include cost of valve and masonry chamber as shown on the drawings with C.I. cover etc., complete with two coat of enamel paint over a coat of enamel paint over a coat of primer.

6) Water meter: It shall consist of meter, "Y" strainer and other accessories shall be fixed as per requirement of the Local Water Supply Authority. The cost of meter shall include the cost of testing and sealing by Municipal Authorities and fixing including a masonry chamber as shown on the drawing, C.I. cover and locking arrangement complete as directed.

7) Manhole chambers and surface chambers for housing valves etc., shall be constructed as per standard drawing.

SECTION – D -MODE OF MEASUREMENT

General :

The description of each item in the Bill of Quantities shall be read in conjunction with its specifications for materials and work and unless otherwise stated shall be held to include for necessary conveyance and delivery, handling, unloading, storing, fabrication, hoisting, lowering, all labour for finishing to the required shape and size, setting, fitting and fixing in position, straight cutting and waste and other incidental operations. Any item not mentioned hereunder shall be measured and paid for as per IS 1200 for the respective item.

External Drainage:

a) Pipes shall be classified according to their diameter. The measurement shall be taken along the center lines of pipes between the inner faces of 2 manholes. The rates shall be inclusive of cutting, jointing, testing and commissioning.

b) Excavation for trenches for laying drainage lines shall be paid as per volumetric measurements. The length of the trench shall be measured along its center line between the outside faces of 2 manholes. The width shall be the average of the width measured at the top and bottom of the trench. The depth shall be arrived at by measuring the depths at, at least 3 places in the trench, and finding the average of the same. If the ground is undulating, then more than 3 readings shall be taken. The volumetric measurements shall be arrived at by length x Average width x Average depth.

c) Excavation in rock shall be paid on volumetric measurements of the stack after deducting 40% of the volume for voids. Volume of the stack shall be arrived at by using Simpson's Rule.

d) Manholes, chambers, septic tank shall have enumerated and paid per number as described under:

1) Unless otherwise stated, net length of all pipes shall be measured including all fittings such as bends, junction etc., in running meters. The length shall be taken along the center line of the pipes and fittings.

2) Length of fittings viz. taps, valves, traps, etc., which are paid under appropriate items shall not be measured under liner measurements as enumerated above.

3) Soil waste and vent pipes shall be measured along the center line of the stack including the connecting bends / tees to W.C. Pan, Nahani trap, etc., and shall be paid as enumerated above.

4) W.C. Pans, Lavatory basins, Sinks, Drain Boards, Urinals, Mirrors, Glass shelf, Toilet Paper Holder, shall be measured by number and shall include all accessories as enumerated in detail specification under each item.

5) Unless otherwise specified, all types of taps, valves, etc., shall be measured by number and paid separately.

6) Manholes, Inspection Chambers, Gully Traps, etc., shall be constructed according to detail specification, and measured by number and paid separately. The depth of Manhole shall mean the vertical distance from the top of the Manhole cover to the Outgoing invert of the main drain channel.

7) Water meter shall include "Y" strainer and other appurtenances required by the local bodies and shall include brick masonry chamber, with lockable cover etc., as per detailed specifications and items shall be measured by number and paid for accordingly or as or Schedule of Quantity.

THEORETICAL MINIMUM CEMENT CONSUMPTION STATEMENT (BASE CPWD)

No	Description of item of work.	Quantity of cement to be used per Unit Quantity work.	Unit.
1	Cement Concrete (Cast in Situ) Plain or Reinforced.		
a.	1:1:2 (1 Cement : 1 Sand : 2 Graded Aggregate).	12.20 Bags.	Cubic Meter
b.	1:1.5:3 (1 Cement : 1.5 sand : 3 Graded Aggregate).	8.00 Bags.	Cubic Meter
c.	1:2:4 (1 Cement : 2 Sand : 4 Graded Aggregate).	6.40 Bags.	Cubic Meter
d.	1:3:6 (1 Cement : 3 Sand : 6 Graded Aggregate).	4.40 Bags.	Cubic Meter
e.	1:4:8 (1 Cement : 4 Sand : 8 Graded Aggregate).	3.40 Bags.	Cubic Meter
f.	1:5:10 (1 Cement : 5 Sand : 10 Graded Aggregate).	2.60 Bags.	Cubic Meter
g.	Providing and laying cement concrete 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded Aggregate of 20 mm. nominal size) including finishing exposed surface with 6 mm. thick cement mortar 1:3 (1 Cement: 3 Fine Sand). Kerbs, Steps, and the like.	7.02 Bags.	Cubic Meter
h.	String or lacing courses, parapets, coping, bed blocks, anchor blocks, plain window sills and the like moldings in cornices, window sills etc.	7.62 Bags.	Cubic Meter
2.	Cement Mortar		
a.	1:1 (1Cement: 1 Sand)	20.40 Bags.	Cubic Meter
b.	1:2 (1Cement: 2 Sand)	13.60 Bags.	Cubic Meter
c.	1:3 (1Cement: 3 Sand)	10.20 Bags.	Cubic Meter
d.	1:4 (1Cement: 4 Sand)	7.60 Bags.	Cubic Meter
e.	1:5 (1Cement: 5 Sand)	6.20 Bags.	Cubic Meter
f.	1:6 (1Cement: 6 Sand)	5.00 Bags.	Cubic Meter
g.	1:2 (1Cement: 2 Stone Dust)	13.60 Bags.	Cubic Meter
h.	1:2 (1Cement: 2 Marble Dust)	13.60 Bags.	Cubic Meter
i.	1:5 (1Cement: 5 Marble Dust)	6.20 Bags.	Cubic Meter
j.	1:1:3 (1Cement: 1 Marble Dust: 3 Stone Dust)	7.60 Bags.	Cubic Meter
k.	White Cement Mortar 1:2 (1 White Cement : 2 Marble Dust)	13.60 Bags.	Cubic Meter
l.	White Cement Mortar 1:3 (1 White Cement : 3 Marble Dust)	10.20 Bags.	Cubic Meter
m.	White Cement Mortar 1:5 (1 White Cement : 5 Marble Dust)	6.20 Bags.	Cubic Meter

3.	Cement Lime Mortar		
a.	1:1:3 (1 Cement:1 Lime putty:3 Sand)	8.20 Bags.	Cubic Meter
b.	1:1:6 (1 Cement:1 Lime putty:6 Sand)	5.00 Bags.	Cubic Meter
4.	Brick Work in All Classes		
a.	In Cement Mortar 1:3 (1 Cement:3 Sand)	2.56 Bags.	Cubic Meter
b.	In Cement Mortar 1:4 (1 Cement:4 Sand)	1.90 Bags.	Cubic Meter
c.	In Cement Mortar 1:5 (1 Cement:5 Sand)	1.56 Bags.	Cubic Meter
d.	In Cement Mortar 1:6 (1 Cement:6 Sand)	1.24 Bags.	Cubic Meter
5.	Half Brick Work in All Classes		
a.	In Cement Mortar 1:3 (1 Cement:3 Sand) With or without hoop iron.	28.56 Bags per 100 Square Meter	
b.	In Cement Mortar 1:4 (1 Cement:4 Sand)	21.28 Bags per 100 Square Meter	
c.	In Cement Mortar 1:5 (1 Cement:5 Sand)	14.50 Bags per 100 Square Meter	
d.	Molding and cornices in brick masonry in cement mortar 1:4 Cement:4 Sand) Joining old brick work with new brick work.	0.18 Bags per 100 Square Meter per cm. girth	
	a) Old Brick in metric or FPS. System with new brick work in metric system in cement mortar 1:4 (1 Cement : 4 Sand).	4.20 Bags per 100 Square Meter	
	b) Old Brick work in FPS. System with new brick work in cement mortar 1:4 (1 Cement: 4 Sand).	5.44 Bags per 100 Square Meter	
6.	Random Rubble Masonry		
a.	Cement Mortar 1:6 (1 Cement : 6 Sand)	1.70 Bags.	Cubic Meter
b.	Cement Lime Mortar 1:1:8 (1 Cement : 1 Lime Putty : 8 Sand)	1.32 Bags.	Cubic Meter
7.	Coursed Rubble Masonry		
a.	Cement Mortar 1:6 (1 Cement : 6 Sand)	1.50 Bags.	Cubic Meter
8.	Ashlar Masonry In plain ashlar punched (ordinary) in superstructure in cement mortar 1:6 (1 Cement : 6 Sand) including pointing with cement mortar 1:2 (1Cement:6 Stone dust) with an admixture of pigment matching the stone shade.	1.08 Bags.	Cubic Meter

9.	Stone Veneering Work For wall lining etc., average thickness 40 mm. to 170 mm. in cement lime mortar 1:1:6 (1Cement:1 Lime Putty:6 Sand) including pointing in White cement mortar 1:2 (1 White Cement : 2 Stone Dust) with an admixture of pigment matching the stone shade.	17.50 Bags per 100 Square Meter	
10.	Marble work in steps jambs, walls, pillars and other plain work in cement mortar 1:4 (1 Cement : 4 Sand) including pointing in White cement mortar 1:2 (1 Cement : 2 Marble dsust).	0.136 Bags per 1.52 Bags per	Cubic Meter (Grey Cement) Cubic Meter (White Cement)
11.	Marble work in steps jambs, walls, pillars and other	1.66 Bags per	Cubic Meter
	plain work in cement mortar 1:4 (1 Cement : 4 Sand) including pointing in cement mortar (1 Cement : 2 Marble dsust).		
12.	Marble work for wall lining (Veneer) work) 2.5 cm. thick in cement mortar 1:3 (1 Cement : 3 Sand) including pointing in White cement mortar 1:2 (1 Cement : 2 Marble dust).	14.28 Bags per 100 Square Metre (Grey Cement) 3.40 Bags per 100 Square Metre (White Cement)	
13.	Marble work for wall lining (Veneer) work) 2.5 cm. thick in cement mortar 1:3 (1 Cement : 3 Sand) including pointing in cement mortar 1:2 (1 Cement : 2 Marble dust).	17.68 Bags per	Square Meter
14.	Marble work for wall lining (Veneer) work) 4 cm. thick in cement mortar 1:3 (1 Cement : 3 Sand) including pointing in White cement mortar 1:2 (1 Cement : 2 Marble dust).	20.40 Bags per 100 Square Metre. (Grey Cement) 3.40 Bags per 100 Square Metre (White Cement)	
15.	Marble work for wall lining (Veneer) work) 4 cm. thick in cement mortar 1:3 (1 Cement : 3 Sand) including pointing in cement mortar 1:2 (1 Cement : 2 Marble dust).	23.80 Bags per 100 Square Metre.	
16.	Cement Concrete Flooring Flooring 1:2:4 (1 Cement : 2 Sand : 4 Graded Stone Aggregate) finished with a floating coat of neat cement including cement slurry rounding of edges and strips etc., but excluding cost of nosing of steps etc., complete.		
a.	25 mm. thick with 20 mm. nominal size stone aggregate.	0.244 Bags	Square Meter
b.	40 mm. thick with 20 mm. nominal size stone aggregate.	0.34 Bags	Square Meter
c.	50 mm. thick with 20 mm. nominal size stone aggregate.	0.404 Bags	Square Meter

d.	75 mm. thick with 20 mm. nominal size stone aggregate.	0.564 Bags	Square Meter
17.	Cement Plaster Skirting (upto 30 cm. height) with cement mortar 1:3 (1 Cement : 3 Coarse Sand) finished with a floating coat of neat cement including rounding of junctions with floor, including slurry complete.		
a.	18 mm. thick.	0.32 Bags	Square Meter
b.	21 mm. thick.	0.35 Bags	Square Meter
18.	Pavement (25 to 50 mm. thick) with 1:2:4 (1 Cement : 2 Coarse Sand : 4 Graded Stone Aggregate 20 mm. nominal size) including finishing complete.	6.80 Bags	Cubic Meter
19.	Terrazo Flooring 40 mm. thick marble chips flooring rubbed and polished to granolithic finish, under layer 34 mm.		
	thick cement concrete 1:2:4 (1 Cement: 2 Coarse Sand : 4 Graded Stone Aggregate 12.5 mm. nominal size) and top layer 6 mm. thick with white, black or white and black marble chips of size 1 mm. to 4 mm. nominal size laid in cement marble powder 3:1 mix. (3 Cement : 1 Marble Powder) by weight in proportion of 4:7 (4 Cement marble powder) by weight in marble powder mix:7 Marble chips) by volume including cement slurry etc., complete.		
a.	Dark shade / Light shade pigment with ordinary cement.	0.339 Bags per	Square Meter
b.	Light shade pigment with white cement.	0.258 Bags per 0.081 Bags per	Square Meter (Grey Cement) (White Cement)
c.	Medium shade pigment with approximately 50% white cement and 50% ordinary cement.	0.298 Bags 0.0440 Bags per	Square Meter (Grey Cement) (White Cement)
20	40 mm. thick marble chips flooring rubbed and polished to granolithic finish, under layer 31 mm. thick cement concrete 1:2:4 (1 Cement: 2 Coarse Sand : 4 Graded Stone Aggregate 12.5 mm. nominal size) and top layer 9 mm. thick marble chips, chips, size 4 to 7 mm. size, laid in cement marble powder mix. 3:1) (3 Cement : 1 Marble Powder) by volume in proportion of 4:7 (4 Cement marble powder mix. 7 Marble chips) by volume including cement slurry etc., complete.		
a.	Dark shade / Light shade pigment with ordinary cement.	0.357 Bags	Square Meter

b.	Light shade pigment with white cement.	0.241 Bags 0.116 Bags	Square Meter (Grey Cement) Square Meter (White Cement)
c.	Medium shade pigment with approximately 50% white cement and 50% ordinary cement.	0.299 Bags 0.058 Bags	Square Meter (Grey Cement) Square Meter (White Cement)
21	40 mm. thick marble chips flooring rubbed and polished to granolithic finish, under layer 28 mm. thick cement concrete 1:2:4 (1 Cement: 2 Coarse Sand : 4 Graded Stone Aggregate 12.5 mm. nominal size) and top layer 9 mm. thick marble chips, chips, sizes 7 mm to 10 mm. nominal size, laid in cement marble powder mix. 3:1) by weight in proportion of 2:3 (2 Cement Marble Powder mix. 3 Marble Chips) by volume including cement slurry etc., complete.		
a.	Dark or Light shade pigments with grey cement.	0.381 Bags	Square Meter
b.	Light shade pigment or without any pigment with	0.219 Bags	Square Meter
	white cement.	0.162 Bags	(Grey Cement) Square Meter (White Cement)
c.	Medium shade pigment with approximately 50% grey cement and 50% white cement.	0.300 Bags 0.081 Bags	S.M. (Grey Cement) S.M.(White Cement)
22	Marble chips skirting (up to 300 mm high) rubbed and polished to granolithic finish top layer 6 mm. thick marble chips of sizes from smallest to 4 mm. nominal size laid to cement marble powder mix. 3:1 (3 Cement: 1 Marble Powder mix. By weight in proportion of 4:7 (4 Cement Marble Powder mix: 7 marble chips) by volume including cement slurry complete.		
a.	18 mm. thick with under layer 12 mm. thick cement plaster 1:3 (1 Cement: 3 Course Sand) dark or light shade pigment with grey cement.	0.298 Bags	Square Meter
b.	Light shade pigment or no pigment with cement.	0.217 Bags Square Meter (Grey Cement) 0.081 Bags Square Meter (White Cement)	
c.	Medium shade colour pigment with 50% grey cement and 50% white cement.	0.258 Bags Square Meter (Grey Cement) 0.0406 Bags Square Meter (White Cement)	
d.	21 mm. thick with under layer 15 mm. thick cement plaster 1:3 (1 Cement: 3 Course Sand) dark or light shade pigment with grey cement.	0.327 Bags	Square Meter
e.	Light shade pigment or no pigment with white cement.	0.246 Bags Square Meter (Grey Cement) 0.081 Bags Square Meter (White Cement)	

f.	Medium shade pigment with 50% grey cement and 50% white cement.	0.286 Bags Square Meter (Grey Cement) 0.04 Bags Square Meter (White Cement)	
23.	Tile Flooring :		
a.	Precast terrazzo tiles 20 mm. thick white black or white and black marble chips of size up to 6 mm. laid in floors treads of steps and landings jointed with neat cement slurry mixed with pigment to match the shade of the tile including rubbing polishing with precast tiles of 30 mm. thick bed of lime mortar 1:1.2 or 1:3 light shade using white cement.	0.088 Bags Square Meter (Grey Cement) 0.088 Bags Square Meter (White Cement)	
b.	Medium shade colour pigment with 50% white cement and 50% grey cement.	0.132 Bags Square Meter (Grey Cement) 0.044 Bags Square Meter (White Cement)	
c.	Dark shades using ordinary cement precast terrazzo tiles 20 mm. thick with marble chips of size 6 mm. in skirting and risers of steps not exceeding 30 cm. in height on wall, laid on 12 mm. thick cement plaster 1:3 mix. (1 Cement: 3 Sand) joint with neat cement slurry, light shades using white cement.	0.235 Bags Square Meter (Grey Cement) 0.044 Bags Square Meter (White Cement)	
d.	Medium shade colour pigment with 50% white cement and 50% ordinary cement.	0.257 Bags Square Meter (Grey Cement) 0.022 Bags Square Meter (White Cement)	
e.	Dark shades using ordinary cement.	0.279 Bags	Square Metre
24.	Chequered Terrazzo Tile Flooring		
a.	Chequered Terrazzo Tile 22 mm. thick with marble chips of sizes upto 6 mm. in floors, jointed with neat cement slurry mixed with pigment to match the shade of the tiles including robbing, polishing complete on 28 mm. thick bed of lime mortar 1:1.2 or 1:3.		
a.	Light shade using white cement.	0.088 Bags Square Meter (Grey Cement) 0.096 Bags Square Meter (White Cement)	
b.	Medium shades using 50% grey cement and 50% white cement.	0.136 Bags Square Meter (Grey Cement) 0.048 Bags Square Meter (White Cement)	
c.	Dark shade using grey cement.	0.184 Bags Square Meter (Grey Cement)	
d.	Chequered Terrazzo Tile 30 mm. thick with marble chips of sizes up to 6 mm. in stairs, treads, jointed with neat cement slurry mixed with pigment to match the shade of the tiles including rubbing polishing rounding of nosing etc., complete on 20 mm. bed of : Lime mortar 1:1:1 (1 Lime putty:1 Surkhi:1 Coarse Sand) :		
i.	Light shade using white cement.	0.088 Bags Square Meter (Grey Cement) 0.136 Bags Square Meter (White Cement)	

ii.	Medium shades using 50% grey cement and 50% white cement.	0.154 Bags Square Meter (Grey Cement) 0.066 Bags Square Meter (White Cement)
iii.	Dark shade using grey cement.	0.220 Bags Square Meter (Grey Cement)
e.	Cement mortar1:4 (1 Cement:4 Coarse Sand)	
i.	Light shade using white cement.	0.258 Bags Square Meter (Grey Cement) 0.132 Bags Square Meter (White Cement)
ii.	Medium shades using 50% grey cement and 50% white cement.	0.324 Bags Square Meter (Grey Cement) 0.066 Bags Square Meter (White Cement)
iii.	Dark shade using grey cement.	0.39 Bags Square Meter (Grey Cement)
25.	White Glazed Tiles.	
	White Glazed Tiles 5,6 or 7 mm. thick in flooring treads risers of steps skirting and dado on 12 mm. thick cement plaster 1:3 (1 Cement : 3 sand) in base and cement joined with white cement slurry etc. complete.	0.188 Bags Square Meter (Grey Cement) 0.050 Bags Square Meter (White Cement)
26.	Marble Stone Flooring	
	Marble Stone slab flooring over 20 mm. thick base of lime mortar 1:1:1 (1 Lime putty:1 Surkhi:1 Sand) and jointed with grey cement slurry etc. (all marble slabs).	
a.	20 mm. thick	0.098 Bags Square Meter
b.	30 mm. thick	0.102 Bags Square Meter
c.	40 mm. thick	0.107 Bags Square Meter
	Marble stone slab flooring over 20 mm. thick base of cement mortar 1:4 (1 Cement:4 Sand) and	
	jointed with grey cement slurry etc., (all marble slabs).	
d.	20 mm. thick	0.268 Bags Square Meter
e.	30 mm. thick	0.273 Bags Square Meter
f.	40 mm. thick	0.277 Bags Square Meter
g.	Extra if white cement slurry is used instead of grey cement slurry in joints of marble stone flooring.	0.015 Bags Square Meter (White Cement)
h.	Marble slabs 30 mm. thick in risers of steps, skirting dado, wall and pillars, laid on 12 mm. thick cement mortar 1:3 (1 Cement : 3 Sand) and jointed with grey cement slurry.	0.246 Bags Square Meter (White Cement)
27.	Kotah Stone Flooring	
	Kotah stone slab flooring over 20 mm. thick base of lime mortar 1:1:1 (1 Lime putty:1 Surkhi:1 Sand) and jointed with neat cement slurry etc.	
a.	25 mm. thick	0.128 Bags Square Meter
b.	30 mm. thick	0.136 Bags Square Meter
c.	40 mm. thick	0.152 Bags Square Meter

	Kotah Stone slab flooring over 20 mm. thick base of cement mortar 1:4 (1 Cement:4 Sand) and jointed with neat cement slurry etc.		
d.	25 mm. thick	0.298 Bags Square Meter	
e.	30 mm. thick	0.306 Bags Square Meter	
f.	40 mm. thick	0.322 Bags Square Meter	
g.	Kotah stone slab 25 mm. thick risers of steps, skirting, dado and pillar laid on 12 mm. thick cement mortar 1:3 (1 Cement:3 Sand) and jointed with neat cement slurry etc.	0.275 Bags Square Meter	
28	Sand Stone Flooring		
a.	40 mm. thick sand stone flooring over 20 mm. thick base of cement mortar 1:5 (1 Cement :5 Sand) with joints finish flush.	0.155 Bags Square Meter	
b.	40 mm. thick sand stone flooring over 20 mm. thick base of cement mortar 1:5 (1 Cement :5 Sand) including pointing with cement mortar 1:2 (1 Cement : 2 Stone Dust).	0.186 Bags Square Meter	
c.	40 mm. thick sand stone flooring over 20 mm. thick base of lime mortar 1:1:1 (1 Lime :1 Surkhi:1 Sand) including pointing with cement plaster 1:2 (1 Cement :2 Stone Dust).	0.031 Bags Square Meter	
d.	40 mm. thick fine dressed and rubbed stone flooring over 20 mm. thick base of cement mortar 1:5 (1 Cement :5 Sand) with joints 5 mm. thick finished flush.	0.166 Bags Square Meter	
e.	40 mm. thick fine dressed and rubbed stone flooring over 20 mm. thick base of lime mortar 1:5 (1 Cement : 5 Sand) with joints 5 mm. thick including pointing with cement mortar 1:2 (1 Cement : 2 Stone Dust).	0.196 Bags Square Meter	
f.	25 mm. thick cast iron grid flooring using grid tiles of required size weighing 47 kg. per square metre on bed of 12 mm. thick cement concrete 1:2 (1 Cement : 2 Stone Aggregate 6 mm. nominal size) including filling the hollows with cement concrete same mix and tamping with 10 mm. dia. iron bars and grouting the joints with neat cement slurry complete.	0.025 Bags Square Meter	
g.	Filling cement concrete 1:2:4 (1 Cement :2 Coarse Sand : 4 Graded Stone Aggregate 12.5 mm. nominal size) in gaps of A.C.Sheet corrugations and wings of ridges.	3.82 Bags Square Meter	
29.	Cement Plaster		
a.	12 mm. 1:3 (1 Cement : 3 Sand).	14.68	100 Square Metre
b.	12 mm. 1:4 (1 Cement : 4 Sand).	10.94	100 Square Metre
c.	12 mm. 1:5 (1 Cement : 5 Sand).	8.92	100 Square Metre

d.	12 mm. 1:6 (1 Cement : 5 Sand).	7.20 100 Square Metre
e.	15 mm. 1:3 (1 Cement : 3 Sand).	17.54 100 Square Metre
f.	15 mm. 1:4 (1 Cement : 4 Sand).	12.08 100 Square Metre
g.	15 mm. 1:5 (1 Cement : 5 Sand).	10.66 100 Square Metre
h.	12 mm. 1:6 (1 Cement : 6 Sand).	8.60 100 Square Metre
i.	20 mm. 1:3 (1 Cement : 3 Sand).	22.84 100 Square Metre
j.	20mm. 1:4 (1 Cement : 4 Sand).	17.02 100 Square Metre
k.	20 mm. 1:5 (1 Cement : 5 Sand).	13.88 100 Square Metre
l.	20 mm. 1:6 (1 Cement : 6 Sand).	11.20 100 Square Metre
30.	Cement Plaster with a Floating Coat of neat cement	
a.	12 mm. 1:3 (1 Cement: 3 Sand).	19.08 100 Square Metre
b.	12 mm. 1:4 (1 Cement: 4 Sand).	15.34 100 Square Metre
c.	12 mm. 1:3 (1 Cement: 3 Sand).	21.94 100 Square Metre
d.	12 mm. 1:4 (1 Cement : 4 Sand).	17.48 100 Square Metre
e.	15 mm. 1:3 (1 Cement : 3 Sand).	27.24 100 Square Metre
f.	15 mm. 1:4 (1 Cement : 4 Sand).	21.42 100 Square Metre
31.	Cement Plaster in two coats	
a.	20 mm. Cement Plaster in two coats under layer 12 mm. cement plaster 1:4 (1 Cement :4 Sand) finished with a top layer 8 mm. thick cement plaster 1:3 (1 Cement : 3 Sand)	20.00 Bags per 100 Square Metre
b.	18 mm. thick Cement Plaster in two coats under layer 12 mm. thick cement plaster 1:5 (1 Cement :5 Sand) finished with a top layer 6 mm. thick cement plaster 1:3 (1 Cement : 3 Sand)	16.26 Bags per 100 Square Metre
32.	6 mm. Cement Plaster	
a.	6 mm. Cement Plaster to ceiling 1:3 (1 Cement :3 Sand)	7.34 Bags per 100 Square Metre
b.	6 mm. Cement Plaster to ceiling 1:4 (1 Cement :4 Sand)	5.48 Bags per 100 Square Metre
c.	6 mm. Cement Plaster to ceiling 1:3 (1 Cement :3 Sand) finished with a floating coat of neat cement.	11.74 Bags per 100 Square Metre
d.	Neat Cement Punning.	4.40 Bags per 100 Square Metre
33.	Sand Cement Neeru Finished Plaster	
a.	Sand cement smooth neeru finished plaster for ceiling in cement mortar mix 1:4 (1 Cement :4 Sand), 10 to 15 mm. thick average, finished top smooth with neeru.	13.00 Bags per 100 Square Metre
b.	Sand cement smooth neeru finished plaster for walls in cement mortar mix 1:4 (1 Cement :4 Sand), 18 to 20 mm. thick average, finished top smooth with neeru.	19.00 Bags per 100 Square Metre
34.	Rough Cast Plaster	

	Rough Cast Plaster with a mixture of sand and gravel or crushed stone from 2.36 mm. to 12.5 mm. nominal size dashed over and including the fresh plaster in two layers, top layer 10 mm. cement plaster 1:3 (1 Cement: 3 Sand) mixed with 10% finely grounded hydrated lime by volume of cement and under layer 12 mm. cement plaster : 1:4 (1 Cement: 4 Sand)	
a.	With ordinary cement finish or cement pigment finish.	23.18 Bags per 100 Square Metre
b.	With white cement and pigment finish.	10.94 Bags 100 Sqm.(Grey Cement) 12.24 Bags 100 Sqm. (White Cement)
	1:5 Cement Sand (1 Cement:5 Sand)	
c.	With ordinary cement finish or cement and pigment finish.	21.16 Bags 100 Sqm.(Grey Cement)
d.	With white cement and pigment finish.	8.92 Bags 100 Sqm.(Grey Cement) 12.24 Bags 100 Sqm. (White Cement)
35.	Pointing on Stone Work	
a.	Flush or ruled pointing on stone work with cement mortar 1:3 (1 Cement : 3 Sand)	2.34 Bags per 100 Square Metre
b.	Raised and cut pointing in stone work with cement mortar 1:3 (1 Cement : 3 Sand)	3.88 Bags per 100 Square Metre
36.	Waterproofing	
a.	Proprietary waterproofing treatment to the terrace with brick-bat coba, cement base.	55.00 Bags per 100 Square Metre
b.	Proprietary waterproofing treatment to the canopy with brick-bat coba, cement base.	45.00 Bags per 100 Square Metre
c.	Waterproofing chajja with sand cement plaster average 25 mm. thick in cement mortar 1:3 (1 Cement :3 Sand)	25.00 Bags per 100 Square Metre
d.	Proprietary waterproofing treatment to the sunk portion of toilet, cement base.	30.00 Bags per 100 Square Metre

THEORETICAL CEMENT CONSUMPTION STATEMENT (BASE CPWD)

No	Description of item of work.	Quantity of cement to be used per Unit Quantity of work.	Unit.
1.	Cast Iron Pipes		
	Providing and fixing on wall face C.I. rain water pipes including filling the joints with spun yarn soaked in neat cement slurry and cement mortar 1:2 (1 Cement : 2 Sand)		
a.	75 mm. dia pipe	0.132 Bags per 100 Metre	
b.	105 mm. dia pipe	0.176 Bags per 100 Metre	
c.	150 mm. dia pipe	0.264 Bags per 100 Metre	
2.	Cast Iron Accessories		
	Providing and fixing on wall face C.I. Accessories for rain water pipes including filling the joints with spun yarn soaked in neat cement slurry and cement mortar 1:2 (1 Cement : 2 Fine Sand)		
a.	75 mm. dia pipe C.I. Plain bend.	0.0052	Each
b.	100 mm. dia pipe C.I. Plain bend.	0.0062	Each
c.	150 mm. dia pipe C.I. Plain bend.	0.010	Each
d.	75 mm. dia C.I. head flat or corner type.	0.003	Each
e.	100 mm. dia C.I. head flat or corner type.	0.003	Each
f.	150 mm. dia C.I. head flat or corner type.	0.0052	Each
g.	75 mm. dia C.I. plain shoe.	0.003	Each
h.	100 mm. dia C.I. plain shoe.	0.003	Each
i.	150 mm. dia C.I. plain shoe.	0.0052	Each
j.	75 mm.dia C.I. single branch (plain)	0.0052	Each
k.	100 mm. dia C.I. single branch (plain)	0.0062	Each
l.	150 mm. dia C.I. single branch (plain)	0.0010	Each
m.	75 mm.dia C.I. double branch (plain)	0.008	Each
n.	100 mm. dia C.I. double branch (plain)	0.009	Each
o.	150 mm. dia C.I. double branch (plain)	0.0052	Each
p.	C.I. off-sets (plain) 75 mm. dia. 55 mm. projection.	0.0052	Each
q.	C.I. off-sets (plain) 75 mm. dia. 150 mm. projection.	0.0052	Each
r.	C.I. off-sets (plain) 100 mm. dia. 55 mm. projection.	0.0052	Each
s.	C.I. off-sets (plain) 100 mm. dia. 55 mm. projection.	0.0062	Each
t.	C.I. off-sets (plain) 100 mm. dia. 75 mm. projection.	0.0062	Each
3.	A.C. Fittings & Pipes		

	Providing and fixing on wall face asbestos cemen rain water pipes including jointing with spun yar soaked in bitumen and cement mortar 1:2 (Cement 2 Coarse Sand) complete.		
a.	50 mm. dia.	0.150	100 Metre
b.	80 mm. dia.	0.250	100 Metre
c.	100 mm. dia.	0.300	100 Metre
d.	150 mm. dia.	0.320	100 Metre
e.	Providing and fixing A.C. Pipe (or any diameter) wall plugs and standard holder bat clamp comprising of two semi-circular halves of flat an cast iron base screwed on wooden plugs.	0.0004	100 Metre
f.	Providing and fixing on wall face asbestos cemen rain water pipes including jointing with spun yar soaked in bitumen and cement mortar 1:2 (Cement 2 Coarse Sand) complete.		

		50 mm. (2")	80 mm. (3")	100 mm. (4")	Unit
g.	Bend of required degree with door or without door.	0.0072	0.012	0.015	Each
h.	Off-set 52.2 mm. projection.	0.0058	0.0090	0.0116	Each
i.	Off-set 76.2 mm. projection.	0.0058	0.0090	0.011	Each
j.	Off-set 114.3 mm. projection.	0.0058	0.0090	0.0116	Each
k.	Off-set 152.4 mm. projection.	0.0058	0.0090	0.0116	Each
l.	Off-set 228.6 mm. projection.	0.0058	0.0090	0.0116	Each
m	Off-set 304.8 mm. projection.	--	0.0090	0.0116	Each
n.	Off-set 457.2 mm. projection.	--	0.0090	0.0116	Each
o.	Off-set 609.6 mm. projection.	--	--	0.0116	Each
p.	Junction equal single of required degree with or without door.	0.0072	0.0116	0.0146	Each
q.	Junction equal double with or without door or required degree.	0.0108	0.0174	0.0220	Each
r.	Standard shoe.	0.00400	0.0058	0.0058	Each

4.	Sanitary Fittings		
a.	Fixing long pan pattern or Orissa pattern squatting pan or pedestal type water closet 12.5 litres or l litres flushing cistern and brackets, telescopic flus pipe or bend with fittings and clamps, overflow pipe with specials and mosquito proof couplin complete including cutting and making good th walls and floors.	0.10	Each

	Fixing flat back or wall corner type, lipped front urinal basin of 430 x 260 x 350 mm. and 340 x 43 x 265 mm. size respectively, white glaze earthenware with automatic C.I. flushing cister with fittings, brackets, standard size flush pipe and spreaders with brass union and G.I. clamp complete including painting of cistern and fittings cutting and making good the walls and floors.	0.050	Each
b.	One urinal basin with 5 litres C.I. automatic flushing cistern.	0.050	Each
c.	Range of two urinal basins with 10 litres C.I. automatic flushing cistern.	0.08	Each
d.	Range of three urinal basins with 10 litres C.I. automatic flushing cistern.	0.134	Each
e.	Range of four urinal basins with 15 litres C.I. automatic flushing cistern.	0.190	Each
	Fixing white glazed fire clay stall urinal with automatic C.I. flushing cistern with fittings R.S. or C.I. brackets standard size C.P. brass flush pipe and spreaders with unions and clamps, C.I. trap with outlet grating and other coupling in C.P. brass including painting of cistern and fittings, cutting and making good the walls and floors.		
f.	Single stall urinal with 5 litres C.I. automatic flushing cistern.	0.102	Each
g.	Range of two urinal basins with 10 litres C.I. automatic flushing cistern.	0.204	Each
h.	Range of three urinal basins with 10 litres C.I. automatic flushing cistern.	0.306 Bags	Each
i.	Range of four urinal basins with 15 litres C.I. automatic flushing cistern.	0.406 Bags	Each
	Fixing one-piece construction white squatting plate urinal with an integral longitudinal flushing pipe 100 mm. dia. half round channel automatic C.I. flushing cistern with fittings R.S. or C.I. brackets, standard size. G.I. flush pipe for back and front flush with standard spreader pipes with fittings G.I. clamps, white vitreous tiling 1200 mm. high to the front and side walls with white vitreous china corners and angles set in neat cement, standard urinals C.I. trap 65 mm. diameter with vent arm and outlet grating and coupling in C.P. brass complete, including painting the cistern and fittings and making good the walls and floors.		
j.	Single squatting plate with 5 litres C.I. automatic flushing cistern.	0.102 Bags	Each

k.	Range of two squatting plates with 10 litres C.I. automatic flushing cistern.	0.204 Bags	Each
l.	Range of three squatting plates with 10 litres C.I. automatic flushing cistern.	0.306 Bags	Each
m.	Range of four squatting plates with 15 litres C.I. automatic flushing cistern.	0.406 Bags	Each
n.	Fixing lavatory basin with brackets, pillar taps, rubber plug, waste of standard pattern, trap and unions complete including cutting and making good the walls.	0.050 Bags	Each
o.	Fixing white pedestal for wash basin completely recessed at the back for reception of pipes and	0.032 Bags	Each
	fittings.		
p.	Fixing sink with brackets, 40 mm. rubber plus, brass chain, waste, trap with necessary unions complete including cutting and making good the walls.	0.050 Bags	Each
q.	Fixing teal-wood draining board with skirting and beading, wax polished with brackets painted white complete including making good the walls.	0.028 Bags	Each
5.	Sanitary Fittings (Items separately ordered)		
a.	Fixing long pan pattern or Orissa pattern squatting, or pedestal type W.C. pan.	0.050 Bags	Each
b.	Fixing a pair of white glazed earthenware or vitreous china foot rests of standard pattern for Indian type W.C. pan.	0.010 Bags	Each
c.	Fixing flat back or wall corner type lipped front urinal basin of 430 x 260 x 350 mm. and 340 x 430 x 265 mm.	0.020 Bags	Each
d.	Fixing white glazed fire clay stall urinal of standard size.	0.04 Bags	Each
e.	Fixing white squatting plate urinal with integral longitudinal flush pipe. .	0.040 Bags	Each
f.	Fixing wash basin including making all connections excluding cost of fittings.	0.030 Bags	Each
g.	Fixing kitchen sink including making all connections complete.	0.030 Bags	Each
h.	Fixing in position 32 mm. diameter glavanised steel telescopic flush pipe complete including cutting and making good the walls and floor.	0.020 Bags	Each
6.	Sand Cast Iron Pipe and Fittings		

a.	Fixing M.S. holder bat clamp to 100 mm. dia. sand cast iron pipe embedded in cement concrete blocks 10 x 10 x 10 cm. of cement concrete 1:2:4 (1 Cement : 2 Sand : 4 Stone Aggregate) including cost of cutting holes and making good the walls etc.	0.010 Bags	Each
b.	Fixing M.S. stays and clamps for 100 mm. diameter sand cast iron pipe.	0.010 Bags	Each
c.	Fixing M.S. holder bat clamps for 50 mm. diameter sand cast iron pipe embedded in cement concrete block 10 x 10 x 10 cm. of 1:2:4 (1 Cement : 2 Sand : 4 Stone Aggregate) including cost of cutting holes and	0.010 Bags	Each
	making good the walls etc.		
d.	Fixing M.S. stays and clamps for 50 mm. diameter sand cast iron pipe.	0.010 Bags	Each
e.	Fixing sand cast iron trap 100 mm. inlet 100 mm. outlet of self-cleaning design with sand cast iron screwed down or hinged grating with or without vent arm complete including cost of cutting without and making good the wall.	0.050 Bags	Each
f.	Fixing 100 mm. inlet and 50 mm. outlet sand cast iron floor trap of self cleaning design with sand cast iron screwed down or hinged grating with or without vent arm complete including cost of cutting and making good the walls and floors.	0.050 Bags	Each
7.	Asbestos Cement Soil, Waste and Vent Pipes and Fittings		
	Providing and fixing on wall face asbestos cement soil waste and vent pipe including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement: 2 Sand) complete.		
a.	For 100 mm. diameter.	0.300 Bags	100 Metre
b.	For 50 mm. diameter.	0.150 Bags	100 Metre
	Fixing wooden plugs and standards holder bat clamps comprising of two semicircular halves of flat iron and cast iron base screwed on wooden plugs.		
c.	For 100 mm. diameter.	0.0004 Bags	Each
d.	For 50 mm. diameter.	0.0004 Bags	Each
	Providing and fixing A.C. bends of required degree with access door insertion rubber washer 3 mm. thick, bolts and nuts or plain bend of heel rest unitary bend including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement : 2 Sand)		

e.	For 100 mm. diameter.	0.0020 Bags	Each
f.	For 50 mm. diameter.	0.0010 Bags	Each
	Providing and fixing double equal or unequal A.C. junctions of required degree plain or with access door, insertion, rubber washer 3 mm. thick bolts and nuts, including jointing with spun yarn cement mortar 1:2 (1 Cement : 2 Sand) complete.		
g.	100 x 100 x 100 x 100 mm. double equal junctions or 100 x 100 x 50 x 50 mm. double unequal junctions.	0.004 Bags	Each
h.	50 x 50 x 50 50 mm. double equal junctions.	0.002 Bags	Each
	Providing and fixing single equal or unequal A.C. junctions of required degree plain or with access door, insertion, rubber washer 3 mm. thick bolts and nuts, including jointing with spun yarn cement mortar 1:2 (1 Cement : 2 Sand) complete.		
i.	100 x 100 x 100 x 100 mm. single equal junctions or 100 x 100 x 50 x 50 mm. single unequal junctions.	0.0030 Bags	Each
j.	50 x 50 x 50 50 mm. single equal junctions.	0.0016 Bags	Each
	Providing and fixing plain A.C. invert branch of required degree including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement : 2 sand).		

l.	50 x 50 x 50 x 50 mm.	0.002 Bags	Each
m.	50 x 50 x 50 x 50 mm.	0.0016 Bags	Each
	Providing and fixing A.C. offset including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement : 2 Sand)		
n.	100 mm. dia. A.C. offset with any projection.	0.002 Bags	Each
o.	50 mm. dia. A.C. offset with any projection.	0.0010 Bags	Each
	Providing and fixing A.C. loose socket including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement : 2 Sand) complete.		
p.	100 mm.	0.002 Bags	Each
q.	50 mm.	0.0010 Bags	Each
	Providing and fixing A.C. Terminal guard including jointing with spun yarn soaked in bitumen and cement mortar 1:2 (1 Cement : 2 Sand).		
r.	100 mm.	0.002 Bags	Each
s.	50 mm.	0.0010 Bags	Each
t.	Cutting chase in brick masonry walls for fixing 100 mm diameter sand cast iron pipes and making good the same with brick work in cement mortar 1:3 (1 Cement : 3 Sand)	10.00 Bags	100 Metre

u	Cutting chase in brick masonry walls for fixing 50 mm. diameter sand cast iron pipes and making good the same with the brick work in cement mortar 1:3 (1 Cement : 3 Sand).	6.66 Bags	100 Metre
8.	Drainage		
	Jointing glazed stone ware pipes grade "A" with stiff mixture of cement mortar in the proportion of 1:1 (1 Cement : 1 Sand)		
a.	100 mm. dia.	4.34 Bags	100 Metre
b.	150 mm. dia.	6.46 Bags	100 Metre
c.	200 mm. dia.	8.66 Bags	100 Metre
d.	230 mm. dia.	9.74 Bags	100 Metre
e.	250 mm. dia.	10.80 Bags	100 Metre
f.	300 mm. dia.	12.94 Bags	100 Metre
g.	450 mm. dia.	19.54 Bags	100 Metre
	Laying cement concrete 1:5:10 (1 Cement : 5 Sand : 10 Graded Stone Aggregate 40 mm. nominal size) alround S.W. pipe including bed concrete 15 cm. thick.:		
h.	100 mm. dia. S.W. Pipe.	47.32 Bags	100 Metre
i.	150 mm. dia. S.W. Pipe.	50.70 Bags	100 Metre
j.	200 mm. dia. S.W. Pipe.	58.24 Bags	100 Metre
k.	230 mm. dia. S.W. Pipe.	62.92 Bags	100 Metre
l.	250 mm. dia. S.W. Pipe.	66.04 Bags	100 Metre
m.	300 mm. dia. S.W. Pipe.	73.58 Bags	100 Metre
n.	350 mm. dia. S.W. Pipe.	81.12 Bags	100 Metre
o.	400 mm. dia. S.W. Pipe.	88.40 Bags	100 Metre
p.	450 mm. dia. S.W. Pipe.	96.20 Bags	100 Metre
	Laying cement concrete 1:5:10 (1 Cement : 5 Sand : 10 Graded Stone Aggregate 40 mm. nominal size) upto haunches of S.W. pipe including bed concrete 15 cm. thick.:		
q.	100 mm. dia. S.W. Pipe.	31.72 Bags	100 Metre
r.	150 mm. dia. S.W. Pipe.	34.84 Bags	100 Metre
s.	200 mm. dia. S.W. Pipe.	40.56 Bags	100 Metre
t.	230 mm. dia. S.W. Pipe.	44.20 Bags	100 Metre
u.	250 mm. dia. S.W. Pipe.	46.54 Bags	100 Metre
v.	300 mm. dia. S.W. Pipe.	52.26 Bags	100 Metre
w.	350 mm. dia. S.W. Pipe.	58.24 Bags	100 Metre
x.	400 mm. dia. S.W. Pipe.	62.96 Bags	100 Metre
y.	450 mm. dia. S.W. Pipe.	69.94 Bags	100 Metre
z.	Laying light duty non-pressure NP2 or P1 class R.C.C. pipes with collars jointed with stiff mixture of cement mixture of cement mortar in the proportion of 1:2 (1 Cement : 2 Sand) including joints etc.		
Z1.	100 mm. dia. R.C.C. pipe (NP2) or (P1)	1.00 Bags	100 Metre
Z2.	150 mm. dia. R.C.C. pipe (NP2) or (P1)	1.20 Bags	100 Metre
Z3	250 mm. dia. R.C.C. pipe (NP2) or (P1)	1.80 Bags	100 Metre

Z4.	300 mm. dia. R.C.C. pipe (NP2) or (P1)	2.20 Bags	100 Metre
Z5.	450 mm. dia. R.C.C. pipe (NP2) or (P1)	4.80 Bags	100 Metre
Z6.	500 mm. dia. R.C.C. pipe (NP2) or (P1)	5.20 Bags	100 Metre
Z7.	600 mm. dia. R.C.C. pipe (NP2) or (P1)	6.40 Bags	100 Metre
Z8.	700 mm. dia. R.C.C. pipe (NP2) or (P1)	7.40 Bags	100 Metre
Z9.	800 mm. dia. R.C.C. pipe (NP2) or (P1)	8.40 Bags	100 Metre
Z10	900 mm. dia. R.C.C. pipe (NP2) or (P1)	9.80 Bags	100 Metre
Z11	1000 mm. dia. R.C.C. pipe (NP2) or (P1)	11.00 Bags	100 Metre

SAFETY CODE

01. First aid appliances including adequate supply of sterilized dressing and cotton wool shall be ke in a readily accessible place.
02. An injured person shall be taken to a public hospital without loss of time, in case where the inju necessitates hospitalization.
03. Suitable and strong scaffolds should be provided for workmen for all works that cannot safely done from the ground.
04. No portable single ladder shall be over 8 meter in length. The width between the side rails sh not be less than 30 cm (clear) and the distance between two adjacent rungs shall not be more th 30 cm. When a ladder is used an extra mazdoor shall be engaged for holding ladder.
05. The excavated material shall not be placed within 1.5 meters of the edge of the trench or half the depth of trench whichever is more. All trenches and excavations shall be provided w necessary fencing and lighting.
06. Every opening in the floor of a building or in a working platform be provided with suitab means to prevent the fall of persons or materials by providing suitable fencing or railing who minimum height shall be on meter.
07. No floor, roof or other part of the structure shall be so overloaded with debris or materials as render it unsafe.
08. Workers employed on mixing and handling material such as asphalt, cement mortar or concre and lime mortar shall be provided with protective footwear and rubber hand gloves.
09. Those engaged in welding works shall be provided with welder's protective eye-shields a gloves.

10.1 No paint containing lead or lead products shall be used except in the form of paste or readyma paint.

10.2 Suitable face masks should be supplied for use by the workers when the paint is applied in t form of spray or surface having lead paint dry rubbed and scrapped.

TECHNICAL SPECIFICATIONS FOR INTERIOR MATERIALS
SECTION – A - GENERAL

This specification is for work to be done, item to be supplied and materials to be used in the works as shown and defined on the drawings and described herein, all under the supervision and to the satisfaction of the Competent Authority.

Competent authority means Architects / Engineer in charge.

1.1 The workmanship is to be the best and of high standard, use must be made of special trades men in all respects of the work and allowances must be made in the rates for doing so.

1.2 The materials and items to be provided by the contractor shall be approved by the Competent Authority in accordance with any samples which will be submitted for approval by Contractor and generally in accordance with the Specifications Also if products are specified in the catalogue reference, the contractor will be required to obtain the approval of the Competent Authority before using a material. The Contractor shall produce all invoices, vouchers or receipts for any material if called upon to do so by the Competent Authority.

1.3 Samples of all materials are to be submitted to the Competent Authority for approval before the Contractor orders or delivers the materials at site. Samples together with their packing are to be provided free of charge by the Contractor and should any materials be rejected, they will be removed from the site at the Contractor's expense. All samples will be retained by the Competent Authority for comparison with materials, which will be delivered at the site. Also, the Contractor will be required to submit specimen finishes of colours, fabrics etc. for the approval of the Competent Authority before proceeding with the work.

1.4 The contractor shall be responsible for providing and maintaining and boxing or other temporary coverage required for the protection of dresses or finished work if left unprotected. He is also to clean out all shelving's, out ends and other waste from all parts of the works before coverings or in-fillings are constructed.

1.5 Templates, boxes and moulds shall be accurately set out and rigidly constructed so as to remain accurate during they are in use.

1.6 All unexposed surface of timber e. g. false ceiling, backing fillets, backs of door frames, cupboard framing, grounds, etc. are to be treated with two coats of approved timber preservative before fixing or converging.

1.7 Only first-class workmanship will be accepted. Contractor shall maintain uniform quality and consistency in workmanship throughout.

2. JOINERY:

2.1 Joinery is to be prepared immediately after the placing of the contract, framed up, bonded and waged up. Any portions that are wrapped or found with other defects are to be replaced before wedging up. The whole of the work is to be framed and finished in a workmen-like manner in accordance with the detailed drawings wrought and wherever required, fitted with all necessary metal ties, straps, belts, screws, glue etc. Running beaded joints are to be cross-tongued with teak wherever 1½ thick double cross tongued. Joiners work generally to be finished with fine sand/glass paper.

2.2 **Joints:** All joints shall be standard mortise and tenon, dowel, dovetail, and cross-halved. Nailed or glued butt joints will not be permitted, screws, nails etc. will be standard iron or wire of oxidized nettle fold tenon should fit the mortises exactly.

2.3 Nailed or glued butt joints will not be permitted except in exceptional cases with approval of Competent Authority.

2.4 Where screws shown on a finished surface, those will be sunk and the whole plugged with a wood plug of the same wood and grain of the finished surfaces will be neatly punched and the hole filled with wood filler to match the colour.

2.5 Should joints in joiner's work open, or other defects arise within the period stated for defect liability in the contract and the clause thereof, be deemed by the Competent Authority to be due such defective joinery shall be taken down, and refilled, redecorated and/or replaced if necessary and any work disturbed shall be made good at the Contractor's expense.

2.6 Nails spikes and bolts shall be of lengths and weights approved by the Competent Authority. Nails shall comply with is 1959-1960 approved quality sample. Brass-headed nails are to comply with B. S. 1210. Wire staples shall comply with B. S. 1494.

2.7 The contact surface of dowels, tennons wedges etc., shall be glued with an approved adhesive. Where glued, joinery and carpentry works are likely to come into contact with moisture, the glue shall be waterproof.

3.0 HARDWARE AND METALS:

The hardware throughout shall be of approved manufacture or supplier well-made and equal to in every respect to the samples to be deposited with the Competent Authority. The contractor may be required to produce and provide samples from many different sources before the Competent Authority takes decision and he should allow his rates for doing so.

3.1 Fittings generally shall be brass oxidized, unless otherwise specified and shall be suitable for their intended purpose. In any case, it will have to be approved by Competent Authority before the Contractor procures it at site of work.

3.2 Screws are to match the finish of the article to be fixed, and to be round or flat headed or counter sunk as required**.**

3.3 The contractor should cover up and protect the brass and bronze surfaces with a thick grease or other suitable productive material, renew as necessary and subsequently clean off away on connection.

3.4 Aluminum and stainless steel shall be of approved manufacture and suitable for its particular application. Generally, the surface of aluminium shall have an anodized finish and both shall comply with the samples approved by the Competent Authority. All stainless-steel sheets shall be 304 S. S. Japan with gauge as specified but not thinner than 16G.

3.5 All steel, brass, bronze, aluminium and stainless-steel articles shall be subjected to a reasonable test at the Contractor's expense.

3.6 ll brazing and welds are to be executed in a clean and smooth manner rubbed down and left in the flattest and tidiest way, particularly where exposed.

3.7 Chromium plating shall be in accordance with I. S. Standard or as per approved specification for normal outdoor conditions and shall be on a base material of copper or brass.

4.0 GLAZING:

4.1 All glass to be of approved manufacturer complying with IS 3548-1966 as per approved quality and sample to be of the selective qualities specified and free from bubbles, smoke, air holes and other defects.

4.2 Polished plate glass shall be "glazing glass" (G. G.) quality and that for mirrors shall be "silvering quality" (S.G.) conforming to IS 3438-1965 or as per approved sample and quality.

4.3 The compound for glazing to metal is to be a special non-hardening compound manufactured for the purpose and of a brand and quality approved by the Competent Authority.

4.4 While cutting glass, proper allowance be made for expansion. Each square of glazing to be in one whole sheet. On completion of work clean all glass inside and cut, replace all cracked scratched and broken panes and leave in good condition.

5.0 PAINT AND POLISHES:

5.1 All material required for the works shall be of specified and approved manufacturer, delivered to the site in the manufacturer's container's name or trade mark with a description of the contents and colour. All materials are to be stored on the site.

5.2 Spray painting with approved machines will be permitted only if written approval has been obtained from the Competent Authority prior to painting. No spraying will be permitted in the case of priming costs nor where the soiling of adjacent surfaces is likely to occur. The buzzle and pressure to be so operated as to give an even coating throughout to the satisfaction of the Competent Authority. The paint used for spraying is to comply generally with the specification concerned and is to be specially prepared by the manufacturer for spraying. Thinning of paint made for brushing will not be allowed.

5.3 Wood preservative shall be Solignum or other equal and approved impregnating wood preservative and all concealed woodwork shall be treated with wood preservative.

5.4 All brushes, tools, pots kettles etc. used in carrying out the work shall be clean and free from foreign matter and are to be thoroughly cleaned out before being used with a different type of class of materials.

5.5 All iron or steel surfaces shall be thoroughly scraped and rubbed with wire brushes and shall be entirely free from rust, mill scale etc. before applying the priming coat.

5.6 Surfaces of now wood work which to be painted are to be rubbed down, cleaned, down to the approval of the Competent Authority.

5.7 Surfaces of previously painted woodwork which are to be painted are to be cleaned down with soap and water, detergent solution or approved solvent to remove dirt, grease etc. Whilst wet the surfaces shall be flatted down with a suitable abrasive and then rinsed down and allowed to dry. Minor areas of defective paint shall be removed by scraping back to a firm edge and the exposed surface touched in with primer as described and soaked with putty. Where woodwork has been previously painted or polished and it is to be newly polished, with scrapping, burning off or rubbing down and making surface properly.

5.8 Surfaces of previously painted metal which shall be painted are to be cleaned down and flattened down as described in surfaces of any rust and loose scale shall be removed completely by chipping, scrapping and wire brushing back to the bare metal and touched in with primer as described.

5.0 UPHOLSTERY:

5.1 This will be of first class standard workmanship with webbing, no-sag springs, coiled springs, padding and filling as specified on drawing. Covering fabrics will be seen, tufted, and corded as shown on the drawing and as approved by the Competent Authority.

5.2 **Cushion Vents:** Brass "cushion Vents" should be installed at the back or under side or seat cushions (especially those covered in leather vinyl plastic or very tightly woven fabric) to allow air to escape easily and to prevent torn seems.

5.3 **Materials:** Finished timber shall be of the type specified. Furnishing fabrics, colour, pattern, substance to be as specified, no variations of this will be permitted unless with prior approval of the Competent Authority.

6.0 POLISH:

6.1 **French polish:** The basic material shall be shellac dissolved in mentholated spirit.

Preparation:
The timber must be well sanded and cleaned and the grain filled with grain filler. Any staining must be done before applying the polish.

Equipment:
The polishing rubber the most important implement in French polish shall consist of a pad of cotton wool, which acts as a reservoir for the polish, and a cover of soft white linen of cotton fabric, similar to a well-worn handkerchief which acts as a fitter. The rubber must never be dipped into the polish; it should be charged by pouring the polish on to the pad with the cover removed.

Application:
Work evenly over the surface with a slow figure-of-eight motion until the timber is coated with a thin layer of polish. The object is to apply a series of thin coats, allowing only a few minutes for drying between the coats. When a level and even-bodied surface is obtained the work is ready for the second stage i.e. spiriting off.

Allow the work to stand for at least eight hours, then take a fresh rubber with a double thickness of cover material and charge it with mentholated spirit. The object of spiriting off into and remove the rubber marks and to give the brilliance of finish.

Finally, work in the direction of the grain and continue until the surface is free from smears and rubber marks then leave to harden off.

.2 Wax polish:

Wax polish shall contain silicones and driers. A good silicon wax is to be used not a creamy or spray. The timber shall be sealed first with another finish such as Ron seal, before applying wax.

Application:
Apply coat of the sealer by brush or cloth direct to the unfilled timber, working it well in and finishing evenly with the grain. Allow to dry thoroughly then sand lightly with fine abrasive paper. Apply a heavy coat of wax by cloth on flat surfaces, with a stiff brush. Work it well into the timber and finish off by stroking with the grain before leaving to harden. Leave for four hours before rubbing up with a soft brush. Finally, buff the grain with a soft cloth.

7.3 Transparent Coloured Polyurethane (Melamine)

This shall be applied where natural grain of the wood is required to show. Polyurethane gives tough surface which resist chipping, scratching and boiling water.

Application:
Clean off all grease and wax with an abrasive and white spirit, this should not be applied in humid conditions. Apply the first coat, preferably of clear hard glaze with a cloth pad. Leave this to dry for at least six hours, then apply further coats with a paintbrush. If you wait for longer than 24 hours between coats, rub down the previous coat with fine glass paper or a medium grade of steel wool. Obtain a matt finish, if required, by giving a final coat of clear Reseal Matt coat.

8.0 TIMBER:

8.1 Only seasoned Teakwood to be used unless otherwise specified.
8.2 Use of Rose wood wherever specified.
8.3 All the wood shall be properly seasoned, natural growth and shall be free from worm holes, loose or dead knots or other defects, saw die square and shall not suffer warping, splitting or other defects.
8.4 The moisture content shall not exceed 12%.
8.5 All internal frame work shall be treated with approved wood preservative.
8.6 All wood brought to site should be clean shall not have any preservative or other coating/covering.
8.7 All rejected decayed, bad quality wood shall be immediately removed from site.
8.8 All wood brought to site must be stacked-stored properly as per instructions.

9.0 PLYWOOD:

9.1 Plywood/medium density fibre board/teak practical board/ Veneer shall be as specified in the approved list of manufacturers shall be used.
9.2 Commercial ply shall confirm IS-303 of approved make.
9.3 Marine plywood shall generally conform to generally IS-303 BWR or unless specified IS-710-1980(BWP).

1. Particle board shall be phenol formaldehyde bonded and generally conform to IS 3087-1965.

2. Only 3mm to 4mm thick straight-grained groups matching approved veneers shall be used. No extra claim will be entertained for veneer if found of extra thickness.

10.0 RCC/CC WORK (DESIGN MIX CONCRETE)

10.1 RCC work shall be done with Design Mix Concrete. Wherever letter 'M' has been indicated, the same shall imply for the Design Mix Concrete. The Design Mix Concrete will be designated based on the principles given in BIS codes IS:456, IS:10262 & SP:23. Thecondition and specifications stated herein shall have precedence overall conditions and specifications stated in relevant BIS codes/CPWD specifications. The concrete mix shall be designed for specified target mean compressive strength in order to ensure that the work test results do not fall below the acceptance criteria specified for the concrete mix. The Contractor shall design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements specified.

The mix shall be designed with quantities of admixture / plasticizer proposed to achieve required workability & strength. The specifications mentioned here in below shall be followed for Design Mix Concrete.
10.2 The sources of coarse aggregate, fine aggregate & water to be used in concrete work shall be identified by the contractor & he will satisfy himself regarding their conforming to the relevant specification & their availability before getting the same approved by the Engineer-in-Charge.

10.3 Coarse Aggregate:As per CPWD Specifications - 2019 - Vol.I & Vol. II with up to date correction slips.

10.4 Fine Aggregate:As per CPWD Specifications - 2019 - Vol.I & Vol. II with upto date correction slips.

10.5 Water: It shall confirm to requirements laid down in IS:456-2000 / CPWD Specifications - 2019 - Vol.I & Vol. II with upto date correction slips.

10.6 Cement: PPC shall be used for design mix concrete and shall conform to IS-1489 (part-I).

However, if higher grade of cement is used by the contractor nothing extra shall be paid on this account.

10.7 Admixtures / Plasticizers: - The admixture shall confirm to IS:9103, wherein required, the admixture of approved quality and approved make only shall be used to attain the required workability. Nothing extra shall be paid for use of admixtures.

10.8 Grade of Concrete: The compressive strength of various grades of concrete shall be given as below:

Grade Designation	Compressive Strength on 15 cm Cubes at 7 Days (N/mm2)	Specified Characteristic Compressive Strength At 28 Days At (N/ mm2)	Maximum Water Cement Ratio	Minimum Cement to be used in kg per cum
M-25	As Per Design	25	0.50	330
M-30	As Per Design	30	0.45	340
M-35	As Per Design	35	0.45	350
M-40	As Per Design	40	0.40	360

Water cement ratio and slump shall be as per IS:456-2000.

NOTE:

(i) In the designation of a Concrete mix letter M refers to the mix and the number of the specified characteristic compressive strength of 15 cm cube at 28 days expressed in N/mm2.

(ii) It is specifically highlighted that in addition to the above requirements, the maximum **cement content for any grade shall be limited to 380 kg /cum**.

(iii) The maximum cement content for design mix concrete shall be maintained as per the quantity mentioned above. In case where the quantity of cement required as per Design Mix is lower than the quantity specified in the respective item in the "schedule of quantity", necessary deduction for less quantity of cement used shall be made from the contractor.

10.9 The contractor shall engage one of the IIT/NIT/Reputed Govt. Engineering Institutions/Approved Laboratories as directed by the Engineer-in-charge at his own expenses for designing the concrete mix in accordance with relevant IS Codes and to conduct laboratory test to ensure the target strength and workability criteria for a given grade of concrete.

10.10 The contractor shall submit the report on design mix from any of above approved laboratories for approval of Engineer-in-Charge within 30 days from the date of issue of letter of acceptance of the tender as envisaged under Clause-5 of Schedule-F of this bid document. No concreting shall be done until the design mix is approved. In case of white Portland cement and the likely use of admixtures in concrete with ordinary Portland/white Portland cement, the contractor shall design and test the concrete mix by using trial mixes with white cement and / or admixtures also, for which nothing extra shall be payable.

10.11 In case of change of source or characteristic properties of the ingredients used in the concrete mix during the work, a revised laboratory mix design report conducted at laboratory established at site shall be submitted by the contractor as per the direction of the Engineer-in-Charge.

10.12 Trial Batches:

10.12.1 The designed mix proportion shall be checked for target mean compressive strength by means of trial batches.

10.12.2 The quantities of materials for each trial mix shall be sufficient for at least six specimens (cubes) and the concrete required for carrying out workability tests.

10.12.3 The workability of trial mix No. 1 shall be measured and mix shall be carefully observed for freedom from segregation, bleeding and its finishing characteristics.

The water content, if required, shall be adjusted corresponding to the required changes in the workability.

10.12.4 With the modified water content, the mix pro-portions shall be recalculated by keeping with water cement ratio unchanged. The mix proportions, as modified, shall form the Trial Mix No. 2 and tested for the specified strength and workability.

10.12.5 In addition, trial mix No. 3 and 4 shall be designed by keeping water contents same as that determined for trial mix 2 but varying the water cement ratio + 10 percent of the specified value and tested for their design characteristics.

10.13 All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the Contractor including redesigning of the concrete mix wherever required and directed by Engineer-inCharge.

10.14STANDARD OF ACCEPTANCE:

Standard of acceptance of hardened concrete of batch concrete shall be same asspecified in CPWD Specifications / IS:456.)

(i) In case the test results of all the samples are above the characteristic compressivestrength, the concrete shall be accepted.

(ii) In case the test result of one or more samples fails to meet the requirement (i)above, it shall be accepted if both the following conditions are met:-

a) Any individual test result is not less than (fck - S) N/mm2.

b) The mean of test results from any group of four consecutive samples is morethan (fck + S) N/mm2.

Note:- S - Standard Deviation iii) Concrete of each grade shall be assessed separately.

iv) Concrete is liable to be rejected, if it is porous or honeycombed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met.

10.15 The contractor has to arrange at site sufficient centering and shuttering for before two months from stipulated date of start of work. Only MS centering / shuttering and scaffolding material unless & otherwise specified shall be used for all R.C.C. work to give an even finish of concrete surface. However, marine-ply shuttering in exceptional cases as per site requirement may be used on specific request from contractor as approved by the Engineer-inCharge.

10.16 Nothing extra shall be paid for the centering and shuttering, circular in shape whenever the form work is having a mean radius exceeding 6m in plan.

10.17 In order to keep the floor finish as per architectural drawings and to provide required thickness of the flooring as per specifications, the level of top surface of RCC shall be accordingly adjusted at the time of its centering, shuttering and casting for which nothing extra shall be paid to the Contractor.

10.18 As per general engineering practice, level of floors in toilet / bath, balconies, shall be kept 25 mm as required lower than general floors shuttering should be adjusted accordingly and slabs should be laid with slope towards the drainage point. Nothing extra is payable on this account.

10.19 PRODUCTION OF CONCRETE

All concrete shall be produced at site through fully computerized weigh-batching plant of suitable capacity (**not less than 30 cum/hr**) conforming to IS:4925 with the arrangements for automatic dispensing of admixture and having facility of giving print out indicating weight / details of all ingredient of concrete in each lot/ batch and variations from the approved design mix if any. Fully automatic batching and mixing plant having capacity not less than 30 cum/ hour shall be installed at the arranged site by the contractor. The batching and mixing plants shall be dedicated plants for this project. Contractor shall make his own arrangements for the necessary infrastructure for installation of batching plant and other machineries.

However, if due to any reason, contractor wishes to supplement the concrete from Ready Mix Concrete (RMC) supplier, he is permitted to procure the same from the source approved by the Engineer-in-charge at his own cost. In such a situation nothing extra shall be paid to the contractor. All technical requirements such as cement type and minimum cement quantity, w/c ratio, slump, admixture etc. shall be conveyed to RMC supplier by the contractor and contractor shall be wholly responsible for ensuring the property of concrete as required at site, nothing extra shall be paid to the contractor.

The contractor may take some time to install his own batching plants at the arranged site and till the batching plants are installed, the contractor is permitted to procure concrete from approved Ready-Mix Concrete (RMC) supplier for a period of 2 months from date of start of work or the period as agreed by Engineer-in-Charge. Similarly, when the work is nearing completion and daily requirement of concrete is very less, if agreed by the Engineer-in-Charge, the contractor may be permitted to procure the concrete from approved Ready-Mix Concrete (RMC) supplier and nothing extra shall be paid to the contractor on this account.

10.20 TRANSPORTATION, PLACING AND COMPACTION OF CONCRETE

Mixed concrete from the RMC / Batching plant shall be transported to the point of placement by transit mixers and placed in position through concrete pumps and/or steel closed bottom buckets capable of carrying minimum 0.6 cum concrete. In case the concrete is proposed to be transported by transit mixer, the mixing speed shall not be less
than 4 rev/min. of the drum nor greater than a speed resulting in a peripheral velocity of the drum 70 m/minutes at its largest diameter. The agitating speed of the agitator shall be not less than 2 rev/min nor more than 6 rev/min of the drum. The number of revolution of the mixing drum or blades at mixing speed shall be between 70 to 100 revolutions for a uniform mix, after all ingredients, have been charged into the drum. Unless tempering water is added, all rotation after 100 revolutions shall be at agitating speed of 2 to 6 rev/min and the number of such rotations shall not exceed 250. The general construction of transit mixer and other requirement shall conform to IS:5892.

In case concrete is to be transported by pumping, the conduit shall be primed by pumping a batch of mortar through the line to lubricate it. Once the pumping is started, it shall not be interrupted (if at all possible) as concrete standing idle in the line is liable to cause a plug. The operator shall ensure that some concrete is always there in the pump receiving hopper during operation. The lines shall always be maintained clean and shall be free of dents at all stages. Special precaution shall be taken that surrounding temperature during concreting shall not exceed 30 degrees centigrade.

Except where otherwise agreed to by the Engineer-in-Charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 450 mm. Unless agreed to by the Engineer- in-Charge, concrete shall not be dropped into place from a height exceeding 1.5m. In order to avoid such situations chutes, tremie pipe or closed bottom buckets shall be used. These shall be kept clean and used in such a way as to avoid segregation. Slope of the chute shall be so adjusted that concrete flows without the use of excessive quantity of water. The delivery end of chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the formwork. The concrete shall be compacted by using immersion type vibrators. When the concrete is being continuously deposited to a uniform depth along a member, vibrator shall not be operated within one meter of free end of the advancing concrete. Every effort shall be made to keep the surface of the previously placed layer of concrete alive so that the succeeding layer can be amalgamated with it by the vibration process. In case the concrete in underlying layer has hardened to such an extent that it cannot be penetrated by the vibrator but is still fresh (that is, just after initial set), unimposed bond shall be achieved between the top and underlying layer by first scarifying the lower layer before the new concrete is placed by systematically and thoroughly vibrating the new concrete. The points of insertion of vibrator in the concrete shall be so spaced that the range of action overlap to some extent and the freshly filled concrete is sufficiently consolidated at all locations. The spacing between the dipping positions of vibrator shall be maintained uniformly throughout the surface of concrete so that concrete is uniformly vibrated. The vibrating head shall be regularly and uniformly inserted in the concrete so that it penetrates of its own accord and shall be withdrawn slowly whilst running so as to allow redistribution of concrete in its way and allow the concrete to flow back into the hole behind the vibrator. The vibrator head

shall be kept in one position till the concrete within its influence is completely consolidated. Vibration shall be continued until the coarse aggregate particle have blended into the surface but have not disappeared. The contractor shall keep at least one additional vibrator in serviceable condition to be used in the event of breakdowns and maintenance problems.

The vibrator head shall not be brought more than 200 mm near to the formwork as this may cause formation of water stagnations. The formwork shall be strong and great care shall be exercised in its assembly. It shall be designed to take up increased pressure of concrete and pressure variations caused in the neighborhood of vibrating head, which may result in excessive local stress on the formwork. The joints of the formwork shall be made and maintained tight and close enough to prevent the squeezing out slurry or sucking in of air during vibration. The formwork to receive concrete shall be cleaned and made free from standing water, dust, etc. The contractor shall keep provision for screed and shutter vibrators at site.

No concrete shall be placed in any part of the structure until the approval of Engineer-in- Charge has been obtained. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-Charge. Concreting shall be don continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. The 13 mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete.

Where concrete is not fully hardened, all latency shall be removed by scrubbing the wet surface with wire or bristle brushes. Care shall be taken to avoid dislodgement of particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. Particular attention shall be given to corners and close spots.

In case of rejection of concrete on account of unacceptable compressive strength, governed by para “Standard of Acceptance” as above, the work for which samples have failed shall be redone at the cost of contractor. However, the Engineer-in-Charge may order for additional tests (like cutting cores, ultrasonic pulse velocity test, load test on structure on part of structure, etc) to be carried out at the cost of contractor to ascertain if the portion of structure wherein concrete represented by the sample has been used, can be retained on the b sis of results of individual or combination of these tests. The Contractor shall take remedial measures necessary to retain the structure as approved by the Engineer-in-Charge without any extra cost. However, for payment, the basis of rate payable to contractor shall be governed by the 28 days cube test results and reduced rates shall be regulated in accordance with para 3.24.2.

11.0 SHUTTERING / FORM WORK

11.1 The work shall be done in accordance with CPWD Specifications - 2019 - Vol. I & Vol. IIwith upto date correction slips.

11.2 Steel shuttering as approved by the Engineer-in-Charge shall be used by the contractor. Minimum size of shuttering plates shall be 600mm x 900mm except for the case when closing pieces required to complete the shuttering panels. Dented, broken, cracked, twisted or rusted shuttering plates shall not be allowed to be used on the work.

11.3 The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or debonding compound shall be applied on the surface of the shutter plates in the requisite quantity before assembly of steel reinforcement.

11.4 The joint filler shall be resilient closed cell expanded polyethene and non-tainting as manufactured by Supreme Industries Ltd.

11.5 Providing joint filler of required thickness in position to substrate using either double sided foam adhesive tape or neoprene synthetic rubber adhesive. When forming expansion joint with the Board in in-situ concrete, joint sealing slots can be readily formed in the following matter

a) Before installing, simply cut off a strip of the required depth. Then install the filler flush with the finished surface.

b) Prior to sealing, the top strip can then be pulled easily from the joint to provide an uncontaminated sealing slot ready for preparation and sealing.

12.0 REINFORCEMENT

12.1 The reinforcement shall be done as per CPWD Specifications - 2019 - Vol.I & Vol. II with upto date correction slips.

12.2 The item of reinforcement of RCC work includes all operations including straightening, cutting, bending, welding, binding with annealed steel or welding and placing in position atall the floors with all leads and lift complete as per CPWD Specification - 2019 - Vol.I &Vol. II with upto date correction slips.

12.3 To avoid displacement of bars in any direction and to ensure proper cover, only factorymade round type/rectangular cover blocks shall be used by the contractor. Nothing extra shall be payable on this account.

13.0 BRICK/AAC BLOCK WORK

13.1 Unless otherwise specified FPS Bricks shall be used in all items of brick work. The classification of bricks brought by the contractor shall strictly conform to CPWD Specifications – 2019 Vol-1 & II with upto date correction slips or as specified. The work shall also include for leaving chases / notches for dowels / cramps for all kinds of cladding to come over brick work.

13.2 The AAC Blocks shall be procured from a reputed manufactures as per approved makelist with the approval of Engineer-in-charge.

13.3 The blocks shall be stored at site in stacks on a level dry surface.

13.4 The mortar used for joining the blocks shall be mixed in the proportion 1:1:6 (1Cement: 1Lime: 6 Sand) by volume or with polymer modified block laying adhesive mortar.

13.5 The thickness of joints in the masonry shall not exceed 10 mm and shall be of uniform thickness.

13.6 Maximum height of wall built on any day shall not be more than 1.2 metres (i.e. 6 layers).

13.7 The joints in the masonry shall be recessed and no flush pointing shall be done.

13.8 A slip membrane with PVC sheet shall be introduced as per the recommendation of blocks manufacturer before laying the first course on the plinth beam.

13.9 The blocks shall not be soaked in water and instead they shall be dipped in water and taken out immediately to have only moist surface.

13.10 The vertical joints of the masonry shall be broken to have a minimum overlap of 100 mm.

13.11 Bed joint reinforcement bars may be placed in the joints after every 4th course in two successive layers as per the recommendation of the manufacturers to have good lateral stability.

13.12 It shall be ensured that the lintels are rest at either end of window opening only on full blocks and not on half or part blocks reinforcement shall be placed in the sill course of window openings in two successive horizontal joints and extend the same at least to 600mm on either side of the jams surface.

13.13 At a RCC column interface an MS anchor ("L" – shape) may be placed and fixed with screws at every 4th course so as to anchor the wall with RCC column for better lateral stability.

13.14 Curing of the masonry shall be done only by spraying water and no flooding shall be done by water jets / buckets.

13.15 The chases in the wall surface for electrical conduits shall be done only by means of electrically operated saw to cut two parallel lines and the portion between the cuts shall be chiselled carefully. The depth of vertical chases should be limited to 1/3rd of wall thickness and horizontal chases should not be more than 1/6th of wall thickness. The chases have to be properly packed with cement mortar 1:8 (1 cement: 8 sand) between pipes and chases.

13.16 The blocks shall be cut using a carpenter saw to have half blocks or any other suitable size block to close the masonry course or to break the vertical joint from the bottom course. Hammer or a masons trowel shall not be used to cut the blocks.

13.17 The thickness of plaster shall be limited to 12 mm on internal wall surface and 15 mm on external wall surface. The mortar for plastering shall be in the proportion 1:1:6 for external wall surface and 1:2:9 for internal wall surface i.e.1 cement: 2 lime : 9 fine sand.

13.18 Plaster mesh shall be fixed on all column wall and beams wall junctions before taking up the plaster work.

14.0 SCAFFOLDING

14.1 Double steel scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

15.0 WOOD WORK/WPC WORK

15.1 The wood work in general shall be carried out as per CPWD Specifications - 2019 Vol.I &II with upto date correction slips.

15.2 The samples of species of timber to be used shall be got approved and deposited by the contractor with the EE before commencement of the work. The contractor shall produce cash vouchers and certificates from kiln seasoning or/and chemical treatment plants about the timber section to be used on the work having been kiln seasoned or/and chemically treated by them.

15.3 Factory made shutter as specified shall be obtained from factories approved by the Engineer in charge. The contractor shall inform well in advance to the Engineer-in-charge the names and address of the factory from where the contractor intends to get the shutters manufactured. The contractor will place order for manufacture of shutters only after written approval of the Engineer-in-charge in this regard is given. The contractor is bound to abide by the decision of the Engineer-in-charge and recommend a name of another factory from the approved list in case the factory already proposed by the contractor is not found competent to manufacture quality shutters. Shutters will however be accepted only if this meet the specified tests. The contractor will also arrange stagewise inspection of the shutters at factory to the Engineer-in-charge or his authorized representative. Contractor will have no claim if the shutters brought at site are rejected by Engineer-in-charge in part or in full lot due to bad workmanship /

quality even after inspection of factory. Such shutters will not be measured and paid and the contractor shall remove the same from the site of work within 7 days after the written instruction in this regard are issued by Engineer in Charge or his authorized representative.

15.4 All fittings and fixtures shall be got approved from the Engineer-in Charge before procurement well in advance and the approved samples shall be kept at site till completion of the work.

15.5 Glazing for toilets shall be of translucent type.

15.6 The shape and size of beading shall be as per drawings. The joints of beading shall be mitred.

15.7 WC door frames work shall be carried out by frame sizes of 45X70mm WPC (Wood Polymer Composite) with 30mm thick WPC (Wood Polymer Composite) shutters as perDSR-2021 item Nos. 26.86.1 and 26.88.1 respectively with PVC corner beading around the frames of matching shade. The frames are to be fixed in prepared openings in the walls. All civil work and tiling should be completed before the fixing of the frames. The frames are to be fixed directly on the plastered wall. In case tiling is to be done in the place the frames are to be fitted, a 50 mm strip should be left untiled at the location where the frames are to be fitted. The frames are erected in the prepared opening such that the vertical members of the door frame are embedded 50 mm in the floor. The frame shall befitted truly in plumb. A minimum of three anchor bolts or screws of size 65/100 shall be used to fix each vertical member. One bolt shall be fixed at 200 mm from the top member and one bolt shall be fixed at 200 mm from the floor. The third anchor bolt shall be fixed in the center. The top horizontal member shall be fixed using two 65/100 size anchor bolts or screws at a distance of 200 mm from both the corners.

16.0 STEEL WORK

16.1 Work shall be carried out as per CPWD Specifications - 2019 - Vol.I & Vol. II with UpToDate correction slips.

16.2 The rate of T- angle iron frame shall include the following.

(a) M.S. sill/tie of 10mm dia bar welded to T-iron frames to keep the frames vertical incorrect position. The sill / tie shall be embedded in floor concrete. No tie is necessary for window frames.

(b) Each T – iron frame for doors shall have 4 Nos. M.S. lugs 15x3mm, 10 cm long welded to each vertical member of the frame.

(c) M.S. flat 6 x 25mm, 100mm long having threaded holes (No. of flats shall correspond to the no. of butt hinges to be fixed to door / window shutters) shall be welded at appropriate places at the back of the T-iron frames for fixing the required butt hinges to the frame with machine screws.

16.3 All welded structural steel work shall be tested for quality of weld as laid down in IS:822-1970 before actual erection if required.

17.0 FLOORING

17.1 All work in general shall be carried out as per CPWD Specifications- 2019 - Vol.I & Vol. II with upto date correction slips.

17.2 Whenever flooring is to be done in patterns tiles/ stone, the contractor shall get samples of each pattern laid and approved by the Engineer-in-Charge before final laying of such flooring for which nothing extra shall be paid.

17.3 Different stones/ tiles used in pattern flooring as per the approved architectural drawings and nothing extra for laying pattern flooring shall be paid. No additional wastage if any shall be accounted for any extra payment.

17.4 The proper gradient shall be given to flooring for toilets, verandah, kitchen, court yard, etc.as per the directions of Engineer-in-Charge. For this there may be extra thickness of dry mortar below the tiles/stone slabs. These gradients

should be insured in the shuttering itself. Nothing extra shall be paid for this as this shall to be included in the tendered cost.

17.5 The rate of items of flooring is inclusive of providing sunken flooring in bathrooms, kitchen, balcony etc. and nothing extra on this account is admissible. The floor below work top shall be raised by 75mm with granite skirting and flooring. The samples of flooring, dado & skirting as per approved pattern shall be prepared & got approved from the Engineer-in-charge before execution of work.

17.6Ceramic Tiles/Vitrified Tiles Work/ Granite stone flooring

17.6.1 Work shall be carried out as per CPWD Specifications- 2019 Vol I & II with up to date correction slips and as per manufactures specifications.

17.6.2 Rates shall be inclusive of all operations including labour, material, T&P, scaffolding etc. complete. Nothing extra shall be payable on any account.

17.6.3 One-piece Granite stone for treads / risers in staircase shall be used and nothing extra shall be paid on this account.

17.6.4 POP protection layer shall be laid on all finished floors for protection from damage during execution of other items of work in that area which shall be removed and cleaned just before handing over of the premises for which nothing extra shall be paid.

17.6.5 The testing of tiles shall be carried out at prescribed frequency and methodology as per IS 13630.

17.6.6 The testing of granite slabs shall be carried out at frequency of one test for each lot.

17.6.7 PVC beading of required size at all exposed corner of the tile dado has to be provided in corridor and toilets for which nothing extra shall be paid.

18.0 WATER PROOFING TREATMENT

18.1 Work shall be executed as per CPWD Specifications, 2019 Vol I & II with upto date correction slips.

18.2 The contractor shall associate himself with the specialized firm, to be approved by the Engineer-in-charge in writing, for water proofing treatment for basement/lower ground floor, underground tank and on roofs.

18.3 The brick bats shall be from over burnt bricks. The water proofing compound used in integral water proofing treatment shall satisfy all the performance requirements indicated in IS:2645 and shall be got tested before its use. The compound shall be used @ 2% by weight of cement used or as recommended by the manufacturer.

18.4 Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approved of the Engineer-in-Charge in writing. Materials shall be kept under double lock and key and proper account of the water proofing compound used in the work shall be maintained. It shall be ensured that the consumption of the compound is as per specified requirements.

18.5 The finished surface after water proofing treatment for roof slab shall have smooth slope with minimum gradient of 1 in 80.

18.6 Before commencement of treatment on roof surface, it shall be ensured that the outlet drain pipes/ spouts have been fixed and the spout opening have been eased and rounded off properly for easy flow of water.

18.7 The surface where the water proofing is to be done shall be thoroughly cleaned with wire brushes. All loose scales mortar splashes etc. shall be removed and dusted off. The surface shall be treated with neat cement slurry admixed with proprietary water proof compound to penetrate into crevices and fill up all the pores in the surface.

18.8 This cement slurry shall be applied at the junction of parapet and terrace slab including the vertical face of the parapet.

18.9 After the slurry coat is laid, layer of over burnt brick bats shall be laid in cement mortar of mix as specified by specialist firm but not leaner than 1:5 (1 cement : 5 coarse sand)admixed with proprietary water proofing compound to required gradient and joints filled to half the depth. The bricks bat layer shall be rounded at the junction with the parapet and tapered towards top for a height of 300mm. Curing of this layer shall be done for 2 days.

18.10 After curing the surfaces shall be applied with a coat of cement slurry admixed with proprietary water proofing compound.

18.11 Joints of bricks bat layer shall be filled fully with cement mortar of mix as specified by the specialist firm but not leaner than 1:5 (1 cement : 5 coarse sand) admixed with proprietary water proofing compound and finally top finished with average 20 mm thick layers of cement mortar 1:4 (1 cement : 4 coarse sand) and finished smooth with cement slurry mixed with proprietary water proofing compound. The finished surface shall have marking of 300x300 mm false squares to give the appearance of tiles.

18.12 Curing of water proofing treatment shall be done for a minimum period of two weeks by flooding the water by making compartments etc.

18.13 MESUREMENTS: The measurements shall be taken for plan area of terrace only. Length and breadth shall be measured correct to one centimeter and area shall be worked out tonearest 0.01 sqm. No deduction in measurements shall be made for either opening or recesses for chimneys, stacks, roof lights and the like of areas up to 0.10 sqm nor anything extra shall be paid for forming such openings. For similar areas exceeding0.10 sqm, deductions will be made in measurements for full openings and nothing extra shall be paid for making such opening.

18.14 Rates: The rate shall include the cost of all labour and materials involved in all the operations described above.

18.15 GUARANTEE:
The water proofing work shall carry Ten Years guarantee to be reckoned from the date of completion of the entire work under the contract against faulty workmanship, finishing, unsound materials, efficiency of water proofing treatment and other related problems. **Ten Years Guarantee bond** in prescribed Performa attached herewith as **Annexure-II** shall be submitted by the contractor which shall also be signed by both the specialized agency and the contractor to meet their liability / liabilities under the guarantee bond. However, the sole responsibility about efficiency of water proofing treatment shall rest with the main contractor.
Ten percent of the cost of water proofing work shall be retained as security deposit. This ten percent amount shall be transferred to RBI immediately after completion of work. And the amount so transferred would be released by RBI after ten years from the date of completion of the entire work under the contract, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended to within the specified period, the same will be got done from another agency at the risk and cost of contractor. However, the security deposit deducted may be released in full against bank guarantee of equivalent amount in favour of RBI/ Engineer in charge, if so decided by the Engineer in charge.
The Security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form.

19.0 SPECIFICATIONS FOR ALUMINIUM DOOR, WINDOW, VENTILATOR WORKS:

19.1 Extent and Intent:
19.1.1 The work shall be carried out through an approved specialized agency, who shall furnish all materials, labour, accessories, equipment, tool and plant and incidentals required for providing and installing aluminum doors, windows, claddings, louvers and other items as called for on the drawings. The specialized

agency for the Aluminium work shall be got approved from the Engineer-in-charge, well before actual commencement of the item of work. Necessary performance certificates in respect of agencies proposed to be engaged shall be submitted within 30 days from the date of issue of acceptance letter to substantiate technical capability and experience of the agency for prior approval of the Engineer-in-charge.

19.1.2 The drawings and specifications cover the major requirement only. The supplying of additional fastenings, accessory features and other items not mentioned specifically herein, but which are necessary to make a complete installation shall be a part of this contract.

19.2 General:

19.2.1 Work shall be carried out as per CPWD Specifications- 2019 Vol. I & Vol.II with upto date correction slips.

19.2.2 Aluminium doors, windows etc. shall be of sizes, section details as shown on the drawings. The details shown on the drawings indicate generally the sizes of the components parts and general standards. These may be varied slightly to suit the standard adopted by the manufacturer. Before proceeding with any manufacturing, the contractor shall prepare and submit complete manufacturing and installation drawings for approval of the Engineer-in-Charge and no work shall be performed until the approval of these drawings is obtained.

19.3 Shop Drawings:

The contractor shall submit the shop drawings of doors. Windows, louvers, cladding and other aluminum work, based on architectural drawings, to the Engineer-in-Charge for his approval. The drawings shall show full size sections of doors, windows etc. thickness of metal (i.e. wall thickness), details of construction, sub frame/ rough ground profile, anchoring details, hardware as well as connection of windows, doors and other metalwork to adjacent work. Samples of all joints and methods of fastening and joining shall be submitted to the Engineer-in-Charge for approval well in advance of commencing the work.

19.4 Samples:

Samples of doors, windows, louvers etc. shall be fabricated, assembled and submitted to the Engineer-in-Charge for his approval. They shall be of sizes types etc. as decided by Engineer-in-Charge. All samples shall be provided at the cost of the contractor.

19.5 Sections:

Minimum doors and windows shall be fabricated from extruded section of profile as detailed on drawings. The sections shall be extruded by the manufacturers approved by the Engineer-in-charge. The aluminum extruded sections shall conform to relevant IS designation with chemical composition and technical properties as per IS:733 andIS:1285. The permissible dimensional tolerance of the extruded sections shall be such as not to impair the proper and smooth function/ operation and appearance of doors and windows.

19.6 Fabrication:

Doors, windows, etc. shall be fabricated to sizes as shown at factory and shall be of section, sizes combinations and details as shown in the Architectural Drawings. All doors, windows etc. shall have mechanical joints. All members shall be accurately machined and fitted to form hairline joints prior to assembly. The joint and accessories such as cleats, brackets, etc. shall be of such materials as not to cause any bimetallic action. The fabrication of doors, windows, etc. shall be done in suitable sections to facilitate easy transportation, handling and installation. Adequate provision shall be made in the door and window members for anchoring to support and fixing of hardware and other fixtures as approved by the Engineer-in-Charge.

19.7 Anodizing:

Wherever specified, Aluminium sections shall be anodized as per IS:7088 and to required colour as specified in the item as per IS:1868 grading, after cutting the members to requisite sizes. Anodizing shall be to the specified grade with minimum average thickness of 15 microns when measured as per IS:6012. The anodic coating shall be properly sealed by steams or by boiling in deionized water or cold sealing process as per IS:1868 /IS:6057. Polythene tape protection shall be applied on the anodized sections before they are brought to site. All care shall

be taken to ensure surface protection during transportation, storage at site and installation. The tape protection shall be removed on installation. The sample will be tested in the approved laboratory and cost of samples, cost of testing shall be borne by the contractor.

19.8 Powder Coating:
All aluminum sections shall be powder coated 50 microns to required color as specified in the item and as per direction of Engineer-in-Charge. Polythene tape protection shall be applied on the powder coated section before they are brought to site. All care shall betaken to ensure surface protection during transportation, storage at site and installation. The tape protection shall be removed on installation. The samples will be tested in the approved laboratory and cost of samples, cost of testing, shall be borne by the contractor.

19.9 Protection of Finish:
All aluminum members shall be wrapped with approved self-adhesive non- staining masking tapes.

19.10 Handling and stacking:
19.10.1 Fabricated materials shall be stacking in an approved manner to protect the material against any damage during transportation. The loading and unloading shall be carried out with utmost care, on receipt of materials at site, they shall be carefully examined to detect any damaged pieces. Arrangements shall be made for expeditious replacement of damaged piece/ parts. Materials found to be acceptable on inspections shall be repacked in crates and stored safely.
19.10.2 In the case of Composite windows and doors, the different units are to be assembled first. The assembled Composite units should be checked for line, level and plumb before final fixing is done. Units may be serial numbered and identified as how to be assembled in their final location of situation so warrants.

19.10.3 Where aluminum comes into contact with masonry brickwork, concrete, planter or dissimilar metals, it shall be coated with approved insulation lacquer, paint or plastic tape to ensure that electro- chemical corrosion is avoided. Insulation material shall be trimmed off to a clean flush line on completion.
19.10.4 The contractor shall be responsible for assembling Composite, bedding and filling the groove with backup roads polysulphide sealant inside and outside, placing the doors, windows etc. in their respective opening. After the doors/ windows have been fixed in their correct assigned position, the open hollow sections abutting masonry concrete shall be fitted with approved polysulphide sealant densely packed and neatly finished.
19.10.5 The contractor shall be responsible for doors, windows, etc. being set straight plumb, level and for their satisfactory operation after fixing is complete.

19.11 Installation
19.11.1 Just prior to installation the doors, windows etc. shall be uncrated and stacked on edge on level bearers and supported evenly. The frame shall be fixed into position true to line and level using adequate number of expansion machine bolts, anchor fasteners of approved size and manufacturer and in an approved manner. The holes in concrete/ masonry members for housing anchor bolts shall be drilled with an electric drill.

19.11.2 The doors, windows assembled as shown on drawings shall be placed in correct final position in this opening and marks made on concrete members at jambs, sills and heads against the holes provided in frames for anchoring. The frame shall then be removed from the opening and laid aside. Neat hole with parallel sides of appropriate size shall then be drilled in the concrete members with an electric drill at the marking to house the expansion bolts. The expansion bolts shall then be inserted in the holes, struck with a light hammer till the nuts is forced into the anchor shell. The frame shall then be placed in final position in the opening and anchored to the support through cadmium plated machine screws of required size threaded to expansion bolts. The frame shall be set in the opening by using wooden wedges at supported and bar plumbed in position. The wedges shall invariably be placed at meeting points of glazing bars and frames.

19.12 Neoprene Gaskets:
The contractor shall provide and install Neoprene gaskets of approved size and profile at all locations as shown and as called for to render the doors, windows etc. absolutely airtight and weather tight. The contractors shall produce samples of the gaskets for approval and procure after approval only.

19.13 Fittings:
Hinges, stays, handles, tower bolts, locks and other fittings shall be of excellent quality and manufacturers shall be approved by the Engineer-in-Charge.

19.14 Manufacturer's Attendance:
The manufacturer immediately prior to the commencement of glazing shall adjust and set all windows and doors and accept responsibility for the satisfactory working of the opening frames.

19.15 Mastic Cement:
The gaps between frames and supports and also any gaps in the windows section shall be raked out as directed and filled with mastic cement of approved colour and make to ensure complete water tightness. The mastic cement shall be of such colour and Composition that it would not stain the masonry/ concrete work, shall receive paint without bleeding, will not sag and shall not set hard or dry out under any conditions of weather. The samples of mastic cement to be used for this purpose shall be got approved by the Engineer-in-Charge before its actual use.

19.16 Sealant:
19.16.1 Use modified silicone for joint subject to movement and in glazing.
19.16.2 Surfaces to receive sealant shall be properly prepared, cleaned, primed and excess sealant removed from finished surfaces.
19.16.3 Sealed joints shall be neatly tooled and surfaces smoothed.
19.16.4 Follow the instruction of the sealant manufacturers.
19.16.5 Colour of the sealant shall be approved by the Engineer-in-Charge.

19.17 Glazing:
19.17.1 Glazing shall generally be accomplished from the inside of building.
19.17.2 The glazing system shall be designed to this end use a continuous EPDM compression gasket on both sides (Present Gasket on one side of glazing pocket and roll in gasket on another side). A continuous wet seal shall be employed to ensure a complete water tightness.
19.17.3 Maintain a minimum glazing bite, edge clearance and surface clearance
depending on the glass as recommended by the glass manufacturer.

19.18 Sealant and Gasket Application:
19.18.1 Sealant and gasket shall be provided wherever shown in the drawings or required for a permanently weather tight installation. The sealing mechanism is necessary but is not indicated, it shall be of type recommended by the sub-contractor and approved by the Engineer-in-Charge.

19.18.2 All adjoining surfaces shall be protected to receive sealant against staining by masking and/ or other methods.

19.18.3 Joints and joint surfaces shall be clean, dry, and free of any material that may have an adverse effect on the bonding and/ or seal of the sealant and gasket materials.
19.18.4 Apply sealant and gasket under the conditions recommended by the manufacturer(s). Prime all surface to receive sealant and gasket unless recommended otherwise, use no sealant that has started to set in its container or a sealant that has exceeded the self-life published by the manufacturer.
19.18.5 Fill all joints continuously and completely with sealant, forming a neat, uniform, concave bead. Finish the material flush with adjoining surfaces unless shown on the drawings. All sealant surfaces shall be tooled smooth.
19.18.6 Tensile or shear stress in structural silicone sealant joint shall not exceed 1.4 kg/ sqm.

19.19 Protection & Cleaning: The contractor shall adequately protect all components and accessories from damage during shipments, storage at job site, erection and after completion of the work. At such time as may be directed, the sub-contractor shall remove all protective tapes or coating, thoroughly clean all anodized aluminum and glass surfaces with suitable cleaning agent, make final adjustments to all ventilators, etc. and hardware leaving all in first class working order.

19.20 Acceptance Criteria:
The Aluminium sections shall conform to the provisions of the relevant items. For payment purpose only, actual weight of sections shall be taken into account. However, ifthe sectional weight of any Aluminium section is higher than the permissible variation then the weight payable shall be restricted to the weight of the section including permissible variation.

19.21 Measurement:
Payment by weight shall be made for Aluminium sections including beading only and all fixing angles cleats fittings and fixtures such as handles and hinges etc., shall not be included in the weight to be paid.

19.22 Rates:
The rates of the items shall include the cost of all materials, labors and inputs required

19.23GUARANTEE:
Specialized agency/Manufacturer & Contractor to offer a warrantee on the Aluminium Doors/Windows for a period of Five Years to be reckoned from the date after the expiry of maintenance period prescribed in the contract of the work against faulty workmanship, finishing, unsound materials, structural instability and other related problems. **Five Years Guarantee bond** in prescribed Performa attached herewith as **Annexure-III** shall be submitted by the contractor to meet their liability / liabilities under the guarantee bond. **Five percent of the cost of Aluminium Doors/Windows** shall also be retained as security deposit and the amount so withheld would be released after Five Years to be reckoned from the date after the expiry of maintenance period prescribed in the contract, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended to within the specified period, the same will be got done from another agency at the risk and cost of contractor.
However, the security deposit deducted may be released in full against bank guarantee of equivalent amount in favour of Engineer in charge, if so decided by the Engineer in charge. The Security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form.

20.0 U-PVC WINDOWS & VENTILATORS

20.1 The scope of work comprises supply, laying, installation, commissioning and testing of water supply, sewerage and drainage works including sanitary fixtures and fittings. These works shall be executed as per the specifications of items attached and CPWD specifications- 2019 Vol. I & II with up-to-date correction slips up to the date of tender submission.

20.2 All openable and fixed window system shall have minimum 3 hollow chambers from front to back. The sliding system frames shall have minimum 3 chambers from front to back. The Sliding system Sashes shall have minimum 2 chambers from front to back. The outer profile shall not be less than 56 mm.

20.3 All sections of the frame and sash shall be reinforced in accordance with the system supplier's recommendations using galvanized mild steel in a single continuous length.

20.4GENERAL REQUIREMENT
Profile

The profile is to be extruded from a compound that has been blended to ensure quality and consistency. The material shall be pristine white high impact modified window PVC and shall be conform to BS EN 12608:2003 as below:

Description	Required Value
Flexural modulus of Elasticity Resistance to impact by falling mass at – 10°C for Class II (falling mass 1000g ; falling height 1500mm –as per BSEN 12608:2003)	Shall not be less than 2200 N/mm2 not more than 1 test specimen shall show rupture in wall
Mean Breaking Stress for welded corners	Shall not be less than 35N/mm2 for compression bending test or 25N/ mm2 for tensile bending test

The profile shall be a hollow 3-chamber (across depth) profile with a outer wall thickness not less than 2.2 mm. The profile shall be of first grade/quality uniform and free from foreign bodies, cracks or marks.

Fabrication of Window

i) The window units shall be designed with all corner joints, transom joints and mullion joints being mitred and fusion welded.

ii) All excess material is to be neatly trimmed and neatly feature grooved/raised nib finish at corners, transom joints and mullion joints.

iii) There will be no mechanical joining of the profile. iv) No polishing flush of any joints will be permitted.

v) The window units shall be designed so that the route of drainage is prevented from passing through the reinforcement chamber.

vi) The finished product shall be free from all sharp edges, burrs and the like that maybe hazardous to the user.

vii) The dimensional tolerances on the finished outer frame height and width shall be +3mm. Frame assemblies shall be such that they can be installed square within a maximum difference in the diagonals of 4mm. Minimum overlap of sash on frame shall be 8mm.

viii) In all window units, adequate drainage should be provided to permit the escape of water from platforms or horizontal members beneath each sealed unit. The drainage slots shall not penetrate into the reinforcement chambers. Rainwater Stop to be provided wherever necessary to provide barrier to excess rain water.

Reinforcement

i) Reinforcement shall be made from GI tube of not less then 1.5mm thickness asper strength requirement unless otherwise approved by Engineer in Charge.

ii) Steel reinforcement shall conform to IS 277:2003 or equivalent. Base material of steel shall conform to IS 513:2008 – Drawing Grade.

iii) The reinforcement shall be installed in accordance with the recommended actions. The reinforcement shall conform to the wind load requirements of IS 875:

Part 3. The reinforcement shall be in one continuous length and should be installed minimum 5mm and maximum 10mm from the face of the profile to be welded. iv) The reinforcement shall be secured to the profile so that it does not move or rattle and it maintains the structural integrity of the frame and satisfactory thermal separation. Reinforcement is to be fixed at a maximum of 100mm from the ends and then at a maximum of 300mm centers.

Glazing and Weather Seals

GLAZING

i) Window shall be such that glazing or re-glazing on site is possible without the need to remove the outer frames from the structure of the building.
ii) All glazing is to be packed in accordance with the system supplier's recommendations to prevent any kind of damage during handling.

WEATHER SEALS
i) The weather seals shall be EPDM/ Silicone seals. ASTM- D412 and ASTM- D2240are standard specifying test methods for Tensile strength and Hardness of the gasket whereas the required value shall be specified Ultimate tensile strength min >7.5 N/mm2 ii) The weather seals are to be fitted in continuous lengths and grooves. The joints in the vent weather seal are to be positioned at the bottom and in the outer frames at the top.

Security and Safety
Fasteners shall be designed so that they cannot be released from the outside by the insertion of a thin blade.
No opening light shall be openable or removable from the outside, when it is fastened in the closed position, except by use of special tools or breaking part of the window.

20.5 QUALITY CONTROL AND TESTING OF MATERIALS

Raw Material
The material from which the profiles are made shall consist substantially from white polyvinylchloride as per BS EN 12608:20003. Only those additives and pigments may
be used that are needed for the manufacture of the compound and its subsequent conversion into sound, durable extrusions of good surface finish and mechanical strength, as assessed by the requirements of this specification.
Profile Properties
Appearance and Finish
The color of the profile shall be uniform and the color of all profiles in a system shall be uniform. The profile shall be free from foreign bodies, cracks or sink marks when viewed by normal corrected vision at 90o to the surface and at a distance of 1 meter in normal diffused north light.
Dimensions and Weights
The profiles shall be straight such that the longitudinal axis of the profile, as measured on the face surfaces, may deviate from the straight line by no more than 1mm per meter. The cross section of the profile shall conform in shape and dimensions and may deviate by no more than + 0.5mm; glazing channels and seal grooves may deviate by not more than +0.3mm. The weight of the profile per meter shall not be more than 5% below the nominal value.

Window properties:
U-Value : The total Uw – U value of complete window shall be 3.3 W/ m2 K Resistance to wind load:
All load bearing members shall be adequately reinforced so as to resist the wind load requirements of IS 875: Part 3. Calculations shall be submitted for all window designs. Air Tightness:
The air infiltration for windows shall not exceed 1 litres/ second m2 @ 75 Pa for both positive and negative pressures (certified for use in air conditioned buildings) Water Tightness:
The water penetration for windows shall be minimum 15 minutes @ 150 Pa as per AS 4420.5.

Installation of Frame
i) Before installation the Installation Team is to make sure that the opening has been prepared and any repair work has been carried out. Allow a 5mm gap between the frame and the opening. The new window shall be set in the prepared opening. Allow for suitable packing blocks. ii) The window shall be fixed into the aperture, by drilling and fixing through the outer frame, to the existing structure using 'Fischer' fixings, F8S type bolts.
iii) The fixings shall be no less than 150mm from corners or transoms/mullions and at no more than 600mm centers. iv) When the frame is securely fixed in position then fit glass and glazing beads. Allow for any necessary glazing blocks and glass lock devices.
v) Check windows for correct operation before proceeding with making good.

vi) No fixings are to penetrate the drainage channels.

vii) The windows shall be first treated with Polyurethane Foam (PU Foam) to enhance insulation against heat and Noise. The gap between masonry and the frame is to be filled with Neutral Cure Silicon (exposed to sun surface) and/or Acrylic Sealant (only for the internal surface). The windows shall be first treated with Polyurethane Foam (PU Foam) to enhance insulation against heat and Noise.
viii) The silicone joints should be covered with Architraves/trims as per direction of the Engineer-in-charge.

Making Good

i) Making good to the external surface of the window frame and finish with a compatible approved low modular silicone sealant to BS5889. All trims and quadrants are to be approved by the Engineer- in- Charge prior to fixing. ii) Allow for making good any disturbed plaster, brickwork and decorations internally and externally including color wash to brickwork. iii) Clean off excess material and check fittings and gearing.
iv) Leave installation clean and in good working order.

GENERAL ITEMS

i) This specification is to be read in conjunction with any other relevant documents and drawings.
ii) Sizes are not to be scaled from any drawings or sketches but should be measured on site prior to manufacture.

Window Accessories

i) Window should be designed and reinforced such that it can withstand the wind load requirements by providing suitable strengthening accessories.
ii) The window shall meet the requirements of water tightness. iii) Trims Shall be used to cover the window to masonry joints.

Window Hardware

i) All slider door/windows are to be provided with multi point locking arrangement with/without key locking facility as per the requirement. The hardware shall be provided as per preferred list attached. The slider locking mechanism handles are of projected/flush type.
ii) Casement window friction stays are to be of G-U or Securistyle or equivalent make of appropriate size and weight bearing capacity, made of SS 304. The stack height of friction stay is to be 16 + 0.5mm. iii) The casement windows are to be provided with multi point locking mechanism of shall be provided as per preferred list attached.

iv) Measurement- Area of window shall be measured for payment correct to a centimeter from outer edge of the window frames.

Rate includes all the materials, glazing, window hardware, labour and fixing etc. all complete.

20.6 GUARANTEE:

Specialized agency/Manufacturer & Contractor to offer a warrantee on the u-PVC Doors/Windows for a period of Five Years to be reckoned from the date after the expiry of maintenance period prescribed in the contract of the work against faulty workmanship, finishing, unsound materials, structural instability and other related problems. **Five Years Guarantee bond** in prescribed Performa attached herewith as **Annexure-III** shall be submitted by the contractor to meet their liability / liabilities under the guarantee bond.
Five percent of the cost of u-PVC Doors/Windows shall also be retained as security deposit and the amount so withheld would be released after Five Years to be reckoned from the date after the expiry of maintenance period prescribed in the contract, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended to within the specified period, the same will be got done from another agency at the risk and cost of contractor.

However, the security deposit deducted may be released in full against bank guarantee of equivalent amount in favour of Engineer in charge, if so decided by the Engineer in charge.
The Security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form.

21.0 SANITARY INSTALLATIONS, WATER SUPPLY AND DRAINAGE

21.1 The scope of work comprises supply, laying, installation, commissioning and testing of water supply, sewerage and drainage works including sanitary fixtures and fittings. These works shall be executed as per the specifications of items attached and CPWD specifications- 2019 Vol. I & II with up-to-date correction slips up to the date of tender submission.

21.2 The work of water supply and sanitary installations shall be got executed by the agency as approved by Engineer-in-Charge.

(i) The entire plumbing drawing and sanitary installation drawing/ details shall be submitted by the contractor and got approved by the Engineer-in-Charge before the execution.

(ii) The entire responsibility for the quality of work will however rest with the building contractor only.

21.3 The work of water supply, internal sanitary installations and drainage etc. shall be carried out as per the bylaws of the Municipal Corporation or any other local body and the contractor shall produce necessary completion certificates from such authority after completion of work.

21.4 All water tanks, taps, sanitary, water supply and drainage pipes fittings and accessories etc. shall conform to the bylaws and specifications of the Municipal Body/Corporation where CPWD specifications are not available.

21.5 The contractor shall engage licensed plumbers for the work and the materials(fixtures/fittings) tested by the local Municipal Body/Corporation wherever required at his own cost. Nothing extra shall be paid/reimbursed for the same.

21.6 All sanitary wares and fittings shall conform to IS standards and to be procured from approved makes. The contractor shall submit samples of all fittings and fixtures proposed to be used to the Engineer-in-charge for his approval. The approved samples shall remain with the Engineer-in-charge till the completion of the work.

21.7 P or S and floor traps (long arm upto 90 cm length or more) in WCs shall be of deep seal type of approved make and shall have a minimum water seal of 75 mm. Floor traps (longarm upto 90 cm length or more) shall have a minimum water seal of 50 mm.

21.8 The pig lead to be used in jointing 100 mm, 75mm, 50 mm SCI pipe joints shall not be less than 0.98 kg, 0.88 kg and 0.77 kg per joint respectively. A variation of 5% is allowed on higher side. However, in case of variation on lower side, the quantity of pig lead less used shall be recovered from the contractor at market rate to be determined by the
Engineer-in-Charge whose decision in the matter shall be final.

21.9 All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural requirements. Wherever necessary the fittings entered to dimensions and pattern desired.

21.10 The rates shall include the cost of cutting chases, holes in walls, floors, RCC slabs etc. Wherever required and making good the same for which nothing extra shall be paid. The work in general shall be carried out as per CPWD specifications.

21.11 Rate includes all materials, labour and all the operations mentioned in the respective items unless and otherwise specifically mentioned.

21.12 The SCI pipe wherever necessary shall be fixed to RCC columns, beams etc. with rawl plugs of approved quality and nothing extra shall paid for on this account.

21.13 All the works shall be completely concealed either within shafts or chases or in fills and dropped ceilings, unless specifically shown in drawings or required otherwise.

21.14 All the works shall be adequate protected against corrosion, so that the whole work is free from damage throughout.

21.15 The contractor shall give a performance test of the entire installation(s) as per standing specifications before the work is finally accepted by making his own arrangements for water supply, electricity etc. and nothing extra whatsoever shall be payable for the same.

21.16 The contractor shall give a satisfactory performance test of the entire installation (s)before the work is finally accepted and nothing extra shall be payable to the contractor on this account.

21.17 The contractor shall be responsible for all the protection of sanitary, water supply fitting sand fixtures against pilferage and breakage during the period of installation until the completion / handing over of the work.

21.18 Before the work is handed over, the contractor shall clean all fixtures removing all plaster, stickers, rust stains and other foreign matter, leaving every part in acceptable condition and ready for use to the satisfaction of the Engineer-in-charge.

21.19 The contractor shall submit completion plans for water supply, internal sanitary installations, electrical ducting, storm water drainage and building drainage work within 30days of the date of completion. These plans are to be submitted on drawings prepared preferably through computers (2 original copy + 4 photocopies) on suitable scales to show the general arrangement and desired details.

21.20 INSPECTION AND TESTING

Inspection and testing of water supply sewerage and drainage installations shall be carried out as per National Building Code 2016 with up to date amendments.

22.0 FIRE CHECK DOORS

22.1 The work shall be carried out through an approved specialized agency/manufacturer, who shall furnish all materials, labour, accessories, equipment, tool and plant and incidentals required for providing and installing Fire Check doors. The specialized agency shall begot approved from the Engineer-in-charge, well before actual commencement of the item of work. Necessary performance certificates in respect of agencies proposed to be engaged shall be submitted within 30 days from the date of issue of acceptance letter to substantiate technical capability and experience of the agency for prior approval of the Engineer-in-charge.

22.2 The fire check door shall not collapse during of hot gases or the flames through the rebate of the gap between the door frame and shutter or through the holes, developed in the shutter during fire.

22.3 Door frame and shutter shall be manufactured as per the nomenclature of the items.

22.4 Door fitting & fixture shall be provided as per the nomenclature of the items.

22.5 Specification: The Fire Check doors shall satisfy:

22.5.1 Stability: The fire check door should not collapse during the rated period of fire under the specified fire conditions. The fire check doors provide safe access to the escape route in the building namely protected corridors and staircase.

22.5.2 Integrity: The fire check doors should not allow the passage of hot gases or the flames or the flames through the rebate or the gap between the door frame and shutters for the duration of its fire rating.

22.5.3 Insulation: The mean temperature of fire door on unexposed side should not exceed 140 degree C above ambient temperature for the duration of its fire rating.

22.5.4 The fire/smoke check door assembly being offered shall be as proto-type tested by CBRI, Roorkee, for the prescribed fire – rating as per BS: 476 Part 20/22 IS: 3614 Part-II.

22.5.5 A test report from CBRI, Roorkee shall be submitted for approval before executing the work.

22.5.6 The tenderer shall employ specialized agency or manufacturer of the fire check door assembly, having their own manufacturing facilities and such agency shall begot approved by the Engineer-in-Charge.

22.5.7 Door frame and shutter in general, be fabricated as per nomenclature of the item of the work and recommendation of the specialized agencies as approved by the Engineer-in-Charge.

22.5.8 Fire check doors shall be of 2-hour fire rated and shall satisfy the three performance criteria of stability, integrity and insulation as per BS 476 part-22 and IS 3614 part-II.

22.5.9 Tenderer shall be responsible for obtaining "No objection Certification from CFO (local authority) for the executed work."

22.6 Hermetically Sealed Unit:

Insulating glass shall be a double-glazed unit comprising two sheets of approved glass panes separated by a spacer, hermetically sealed using primary and secondary sealants. The design of insulating glass system shall consist of:

a) Hollow Spacer Bar - The hollow aluminium spacer bar shall be of required size and shape and shall be colour anodized. The spacer bar shall have two lines of perforations in the inner surface.

b) Desiccant - The desiccant filled in the aluminium spacer bar shall be synthesized crystalline compounds of Aluminium Hydroxide, Caustic Soda and Sodium Silicate which absorbs water molecules. The desiccant shall be of 3 A size (A means Angstrom). The quantity of desiccant used shall not be less than 35 gm/m length of spacer bar. Filled spacer bar frame shall not be stored for more than 6hrs. before assembly and sealing of the unit to ensure proper functioning of the desiccant. The contractor shall submit documentary proof of using the above material in the work.

c) Primary Sealant - The primary sealant BUTYL (NAFTOTHERM BU" or equivalent) shall be single component, thermoplastic solvent free sealing compound based on polyisobutylene. The sealant surface shall be free from cavities, depression and other defects. The contractor shall submit documentary proofing of using the above material in this work.

d) Secondary Sealant - The secondary sealant in double glazed unit shall be silicone sealant. The contractor shall submit documentary proof of using the above material in this work to the entire satisfaction of Engineer-in-Charge. Before application of silicone/polysulphide, the surface shall be cleaned and free from oil, grease, dust and other loose matter. The surface shall be cleaned with alcohol or other suitable solvents. Detergent or soap shall not be used to clean the surfaces. The polysulphide shall be mixed and applied mechanically using automatic mixing machine in the manner approved by Engineer-in-Charge.

22.7 Testing:

One door assembly shall be selected at random out of the entire lot, one for single leaf and one for double leaf and shall be tested for two hours fire rating. The testing shall begot done from CBRI, Roorkee or any other test laboratory approved by the Engineer-in charge. The cost of materials, for testing and transportation/packing, testing charges and other incidental charges, shall be borne by the contractor. In case the door fails to meet the requirement, the entire lot shall be rejected.

22.8 **GUARANTEE:**

Specialized agency/Manufacturer& Contractor to offer a warrantee on the Fire Doors for a period of Five Years to be reckoned from the date after the expiry of maintenance period prescribed in the contract of the work against faulty workmanship, finishing, unsound materials, structural instability and other related problems.

Five Years Guarantee bond in prescribed Performa attached herewith as **Annexure-I** shall be submitted by the contractor to meet their liability / liabilities under the guarantee bond. **Five percent of the cost of Fire Doors s**hall also be retained as security deposit and the amount so withheld would be released after Five Years to be reckoned from the date after the expiry of maintenance period prescribed in the contract, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended to within the specified period, the same will begot done from another agency at the risk and cost of contractor. However, the security deposit deducted may be released in full against bank guarantee of equivalent amount in favour of Engineer in charge, if so decided by the Engineer in charge. The Security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form.

LIST OF APPROVED MATERIAL AND MAKES OF ITEMS

NOTE:-

a) The contractor shall produce samples before procurement of the material for approval of the Employer for all materials required for works. Samples can be submitted from any of the above makes and they shall conform to specifications. Samples as approved by the Employer shall only be used on the works and the decisions of the Employer regarding sample shall be final.

b) In respect of materials for which approved makes are not specified as above, the same shall be decided by Employer and shall be as per sample got approved from Employer before procurement.

c) The contractor shall submit samples of all materials three months before the date of work for approval from the Employer.

d) In case if the makes are mentioned in the BOQ specifications, in that case the said makes as indicated in the BOQ shall prevail upon the makes indicated herein-above and the preference would be given to the BOQ makes and in case if unavailable, only then any make out of the makes of the items mentioned herein-above would be adopted by the contractor, however with the prior approval of the bank and the Architect.

THE APPROVED MAKELIST		
Sl.No	**Items**	**Approved makes**
1	Kitchen sink	Nirali, Diamond, Carysil,
2	Level Controller &Indicator (Water	Auto Pump, Cirrus Engineering,
3	Ball Valve	Zoloto, Leader, Audco.
4	Butterfly Valve	Advance, CRI.
5	Strainer	Zoloto,Leader,Emerald,Sant,DSEngg.,Trishul
6	Pressure Reducing Valve	Leader,Watts,Bermad,Muesco,Singer
7	Float Valve	Muesco,Singer,OCV,Watts,Leader,GG
8	Flexible Connection	Metaflex,Tozen,Mason
9	Automatic Air Vent	Val-matic,Metaflex,APCO
10	Cable	Polycab,Havells,Finolex
11	G.I.PIPES	TATA/JINDAL
12	G.I.FITTINGS	'R'BRAND
13	PIPE BRACKET AND SUPPORTS	HI–TECHORM.S.FABRICATED AS PER DRAWINGS
14	Water Meter	Dasmesh,Sant,Rockwin,Aquamet,Capstan&Kaycee
15	Electronic Flow Meter	Electronet&Krohne(ForbesMarshall)
16	Fire Sealant Material	3M,GE,KBS
17	Butterfly Valve	Audco,Jayahiwa,Zoloto
18	Water heater	Vguard,Racold,Ketco,Bajaj

NOTE:-

Any additional item as per BOQ specifications or as per the instructions of the SBI / Consultants. Any of the above items / other items if any will be as approved by the Consultants & Engineer-in-charge.

In case if the makes are mentioned in the BOQ specifications, in that case the said makes as indicated in the BOQ shall prevail upon the makes indicated herein-above and the preference would be given to the BOQ makes

and in case if unavailable, only then any make out of the makes of the items mentioned herein-above would be adopted by the contractor, however with the prior approval of the bank and the Architect.

MATERIAL MAKE LIST		
SR NO	**DESCRIPTION**	**MATERIAL MAKE**
A	**Civil Works**	
1	Cement	Ambuja/Ultratech / ACC/Lafarge
2	Sand	River Sand Non Course(Locally available)
3	AAC Block Work	Siporex / AAC/Birla Aerocon
4	Water Proofing	Dr. Fixit / Sunanda / Pedilite
5	Vitrified Tiles	Nitco/Kajaria/Nitco/Simpolo
6	Ceramic Tiles	Nitco/Kajaria/Nitco/Simpolo
7	Granite	Natural
8	Italian Marble	Natural
9	Corian/Composite Marble	CMC Kalinga/Stylam/LG
10	HPL(High Pressurized Laminates)	Fundermax/Trespa/Stylam
11	Pest Control	PCI/Godrej HiCare

B	**WOOD WORK & CARPENTRY**	
1	Laminated wood flooring	Pergo / Green lam Mikasa /Green Ply
2	Plywood-Commercial	Green-ply / Century Ply/ Mikasa-Greenlam Ply
3	Plywood-Marine Only in pantry & Cafe	Green-ply / Century Ply/ Mikasa-Greenlam Ply; (with Anti-termite treated) Marine Grade
4	Block Board	Green-ply / Century Ply/ Greenlam; (with Anti-termite treated)
5	Flush Board	Green-ply / Century Ply/ Greenlam; (with Anti-termite treated)
6	Exterior Grade Board (HDHMR) All areas	Green-ply / Century /Tessa
7	Veneer	Green-ply / Century Ply/ Greenlam Ply; (with Anti-termite treated)
8	Laminate	Green Lam /Century/Stylam/Green Panel
9	Adhesive	Fevicol / Jovet
10	Toilet Cubicle Partition	Merino/Stylam
11	PVC Panels for walls & Ceiling	Pare Solutions
12	SPC UV Board/Charcoal Sheet	Decostar/Winsom Décor
13	Ikois Plaster	Elemento/Asian Paints

14	Wall Paper	Elemento/Marshal/Asian Paints
15	Metal Sheet	Nixon Steel / Naman Steel

C	CEILING, PARTITION & GYPSUM	
1	GI framing	Saint Gobain/Gyproc
2	Gypsum Board/POP Bags	Saint Gobain/Gyproc
3	Grid Ceiling	Armstrong / Saint Gobain
4	Accoustic Panel	Techno/Uni Acoustics
5	Glass Wool	UP Twiga/Nobel Corporation/Owens Corning
6	Open Cell Ceiling	Saint Gobain/ Hunter Douglas
7	Fabric Stretch Ceiling	Orange / Barrisol
8	Metal Ceiling/ Metal Perforated Ceiling/Metal Baffel Ceiling	Saint Gobain/ Hunter Douglas
9	Porcellain Tiles for Walls & Ceiling	CMC/Nexion
10	Ecophone Ceiling	SaintGobain/Techno/Uni Acoustic
11	Gypsum Perforated Ceiling	Saint Gobain/Arm Strong

D	HARDWARE, GLASS & ACCESSARIES	
1	Door Hardware - Flush Doors / Glazed Doors	Dorset/Hafele/Hettitch
2	Handle	Dorset/Hafele/Hettitch
3	Metal Fire doors	Saint Gobain & Dorma
4	Fire Rated Glass Partition	Saint Gobain & Dorma
5	Furniture Hardware	hafele/Hettitch/Dorset
6	Glass Partition Hardware	Geze/Dorma
7	Wood Preservatives	Woodguard /Termisil
8	Toughened Glass	Saint gobain / Modi
9	Mirror	Saint gobain / Modi
10	Roller Blinds	Vista/Hunter Douglas
11	Frosted Film	3M/Garware
12	Glass Wool	UP Twiga/Nobel Corporation/Owens Corning
13	Metal Rack & Storage	Sample and approvals needed From the architect

E	**GLASS & BACK PAINTED GLASS**	
1	Glass	Saint Gobain, Modi Guard
2	Back Painted Glass/Flutted Glass/Tinted Glass	Saint Gobain

F	**ALUMINIUM & GLASS PARTITION**	
1	Modular Glass Partition	Red Plus Glass Partition/Orno Glass Partition
2	Aluminium skirting	Red Plus Glass Partition/Orno Glass Partition
3	Glass Partition Hardware	Geze/Dorma
G	**PAINT & POLISH**	
1	Paint	Jotun/Asian/Berger/Dulux/Opus
2	Laquar/ Polish	Jotun/Asian/Berger/Dulux/Opus
4	Cement Paint / external paint	Asian/Snowcem/Nitcocem
H	CARPETS, VINYL FLOOR, & WOODEN FLOOR	
1	Carpets	Milikan/Shaw/Interface
2	Vinyl Floor	Response Antistatic
3	Wooden Floor	Pergo / Green lam Mikasa /Green Ply
4	Raised Flooring	Arm Strong/Alstrong/King Span
I	MODULAR FURNITURE & SOFAS	
1	Modular furniture	Featherlight/ Monarch/Godrej/Minister

LIST OF RECOMMENDED MATERIALS – INTERIOR & CIVIL WORKS

S. No	Material / Product	Approved Brand / Manufacturers
1.	Commercial / Marine Plywood Grade phenol Bonded	B.W.P (710) / B.W.R Anchor, Century, Everest Ply, Green, Samrat Ply
2.	Particle Board & MDF (Exterior Grade	Kenwood, Euro Board, ASIS Industries, Archid Ply (Plain & Pre-veneered),

	Eco Friendly, Wood free)	Action TESA, Duro, Green
3.	Veneers (Natural)	Duro, Green, Century, Merino
4.	Laminates	Royal Touch, Greenlam, Samrat, Century, Merino
5.	Hardware, Fittings & Fixtures of any type	Kich, Dorma, Hettich, Hafele India, Godrej
6.	Adhesive	For wood - Fevicol For Stainless Steel, Brass, Glass - Araldite
7.	Paints of all types	Asian Paint, I.C.I. (Deluxe), Nerolac, Berger
8.	Door Closers Floor Springs, Patch fittings	Dorma, Kich, Hettich, Hafele India, Godrej
9.	Locks	Dorma, Kich, Hettich, Hafele India, Godrej.
10.	Wood Preservatives	Asian, Bison - British Paints, ICI
11.	Pest Control	PCI, Godrej, Rentokil PCI
12.	Teak Wood	Best quality teak, Well-seasoned, free from sap, Knots, cracks, Uniform in colour.
13.	Glass & Structural Glazing / Elevational Glazing Glass for Internal / Exterior Glazing	Saint Gobain, AIS, PILKINGTON Saint Gobain, AIS MODI Guard (Modi Guard to be used only for Or Interior Glazing requirements)
14.	LVT Flooring	Forbo, Merino Flooring
15.	Gypsum Board	India Gypsum Ltd, Gyproc,
16.	Mineral Fibre ceiling	Saint Gobain, Armstrong, AMF
17.	Venetian Blinds / Roller Blinds	Hunter Douglas, Vista , Serge Ferrari MAC
18.	(a) Chairs of all types	Godrej, Stanley, Featherlite, Herman Miller, HNI, (Only with the Prior approval of Architect / Engineer in charge)
18	(b) Sofas	Stanley, Durian, Amber, Featherlite, Godrej (Only with the Prior approval of Architect / Engineer in charge)
19.	Tile adhesives	BASF, Roff, Sunanda Specialty Coatings Pvt. Ltd, Krichna, SIKA
20.	Ceramic & Vitrified tiles	RAK, Johnson, Kajaria, NITCO

21.	Plumbing fixtures-Assessories	Jaguar, Marc, KEUCO, Hindware (Executive type – Italian Collection), BRAVAT
22.	Aluminium Sections/Fittings	Jindal, Hindalco, Indal, Bharat
23.	ACP (Aluminium Composite Panels-Exterior & Interior	Alcobond, AluK-Bond, Alstrong Alu Decor
24.	Special Fittings	Dorma, Kich, Hettich, Hafele India.
25.	All Repair Work chemicals	BASF, Sunanda Specialty Coatings Pvt Ltd, Krishna, SIKA.
26.	Flush Doors & Fire Doors	Metal Doors – Godrej, Shakti&Harman Non metal Fire doors- Royale Touch, Green, Wedge India Wooden Fire Doors –Royal Touch, Green, Century
27.	Fire resistant Board	Bison Board of Bison. HILUX, Promatec
28.	Mineral Fibre board	Knauff Armstrong
29.	Insulation Materials	Rockwool, TWIGA
30.	Compactors / Slotted Angle Racks	Balas, Godrej, Steelage
31.	Signages of all types	3M, Llumar.
32.	Sun Control Film & Reflective films	3M, Llumar, Garware
33.	Glazing Sealants	DOW Corning, GE Sealant
34.	PVC Pipes & fittings	Finolex, Prince, Supreme, Astral
35.	Carpets	Mohawk, Shaw, Interface, Forbo
36.	SS Railing	Kich, Hettich, Dorma kaba
37.	Textured Paint	Oikos, Asian Specialty Textures
38.	Keyboards Trays, CPU Trolleys & Pop up Boxes etc	Ebco, Hettich, Innofitt
39.	Teflon / Tensile Fabric / Membranes	Unique Aesthetics Pvt Ltd, Mansi Membranes.
40.	Acrylic Solid surfaces	Corian, Alu décor Granium,Dupont
41.	External Pavers / Flooring	Pavit Ceramic Pvt Ltd, Shakti
42.	Translucent Panels / Cut Panels/ Paneling	EDGE, Translucent Methacrylate sheet – EDGE CREO, EDGE ARTECH Panels or equivalent approved & (With/Without backlit

		arrangements) Acryllic Solid surfaces – Neonnex
43.	MDF Designer boards	EDGE Deco Plus, Re-Invent
44.	Wallpaper	Ego Wall Décor, Muraspec, Vescomm, Asian Paints
45.	White Board, Magnetic Board	ALL ARK, Kings India.
46.	Polycarbonate Sheet	Lexan, Tuflite, Spanko.
47.	Cement Paint	Snowcem, Surfacem, Durocem.

Any additional item as per BOQ specifications or as per the instructions of the SBI / Consultants. Any of the above items / other items if any will be as approved by the Consultants & Engineer-in-charge.

In case if the makes are mentioned in the BOQ specifications, in that case the said makes as indicated in the BOQ shall prevail upon the makes indicated herein-above and the preference would be given to the BOQ makes and in case if unavailable, only then any make out of the makes of the items mentioned herein-above would be adopted by the contractor, however with the prior approval of the bank and the Architect.

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORK
GENERAL:

These specifications are for work to be done, item to be supplied and materials to be used in the works as shown and denned on the drawings and described herein, to the satisfaction of the Owners / Architects.

1.1 The workmanship is to be the best possible and of a high standard. The contractor shall take all steps immediately to make up deficiency if any noticed by the Owners / Architects. Use must be made of special tradesmen in all aspects of the work and allowance must be made in the rates for the same.

1.2 The materials to be provided by the contractor shall be in accordance with the samples already got approved from the Owners / Architects by the contractor and in conformity with specification and approved list of manufacturers and brand. The contractor shall produce all invoices, vouchers or receipts for any material if called upon to do so by the Owners / Architects.

1.3 Samples of all materials are to be submitted to the Owners / Architect for their approval before the contractor orders or delivers the material to the site. Samples together with their packing are to be provided free of charge by the contractor and should any materials be rejected they will be removed from the site at the contactors expense. All samples will be retained by the Owners / Architects for comparison with materials which will be delivered at site. Also, the contractor will be required to submit specimen finishes of colours, fabrics, etc., for the approval of the Owners / Architects before proceeding with the work.

1.4 The contractor shall be responsible for providing and maintaining temporary coverages required for the protection of finished work. He is also to clean out all wood shavings, cut ends and other waste from all parts of the works before covering or infilling are constructed.

1.5 Contractor shall maintain unformed quality and consistency in workmanship throughout the execution of the work.

SECTION - XI

TECHNICAL SPECIFICATIONS (Electrical – part I)

The Electrical installation work shall confirm to the following I.S. Standards (latest additions), Local Supply Authorities Rules and Regulations and Fire Safety Norms.

1) IS:732 Code of Practice for Electrical wiring installation. (System Voltage not exceeding 650V)

2) IS:1646 Code of Practice for fire safety of buildings (General Electrical Installation).

3) IS:9537 (PART-II) 1981Rigid steel conduits for electrical wiring.

4) IS:2667 Fittings for rigid steel conduits for electrical fittings.

5) IS:2509 Rigid non-metallic conduits for electrical installations.

6) IS:1293 Pin Plugs and Sockets.

7) IS:694 PVC insulated cables with copper conductors for voltages up to 1100 volts.

8) IS:9532 Specification for conduits for Electrical Installation.

9) IS:3854 5A & 15A Switch socket and accessories.

10) IS:3043 (1981) Earthing.

11) IS:2026 Specification for power transformer.

12) IS:3639 Specification for fittings and accessories for power transformers.

13) IS:2099 Specification for high voltage porcelain bushings.

14) IS:335 Specification for insulating oil.

15) Indian Electricity Act, 1956 and Rules and Fire Insurance Regulations.

A-01. POINT WIRING

a) METAL CONDUITS

All conduit pipes shall confirm to IS 9537, PART-II 1981. Metal conduits shall be ERW black enameled 20mm/25mm as the case may be depending upon the number of wires permitted as table-1. The conduits shall be fixed to walls/ceiling with MS saddles and spacers at an interval of 0.45 meter and on either side of bends, junction boxes, pull boxes etc.,

All conduit accessories shall be 16 gauge & bends shall be of inspection type. All bends, couplers, threaded portions etc., shall be painted with anti-corrosive paint. Bends in the pipes shall be done with bending hickies.

All pipes shall be cleaned for sharp burrs. Switch boxes shall be of GI 16/14 gauge. The switch boxes shall be concealed as per site requirement & as per Architect's/Consultant's Instructions.

Point shall be controlled with 5A switch or directly from DB as specified in schedule of quantities. Where plate type switches are not specified the switch board shall have 3mm thick hylum sheet on which switches shall be mounted.

The point wiring shall be carried out with multi stranded PVC insulated copper wires of 1.5 sq.mm. 2nos (for Phase & Neutral) & 2.5sq.mm. (for Earth). In all cases the earth shall be of green colour and neutral shall be of black colour. All wires used shall be of 660 V grade. The point wiring shall be inclusive of circuit wiring from Distribution Board to the switch board unless otherwise stated in schedule of quantities. The circuit wiring shall be with 3 nos. of 2.5 sq.mm. PVC insulated multi stranded copper conductors colour coded as detailed above. The rate shall also be inclusive of any chasing as directed by the Architects/Consultant/Client's Engineer to conceal the drops and finishing the same.

In case of group control directly from Distribution Board, the primary point shall be considered from DB to the first point and secondary point shall be from first point to the next looped point. The point shall terminate into the 3 plate-ceiling rose.

While laying the conduits in the slab before casting the slab, all drops shall be laid accurately to fall in position of the switchboard. Junction boxes shall be fixed with sand-cement mortar. All joints shall be airtight. Conduits shall be fastened to the re-enforcement properly so that the conduits do not get dislocated while casting the slab. All conduits shall have 18 SWG fish wire.

b) PVC CONDUITS

The PVC Conduits shall confirm to latest IS standards and shall be of medium gauge unless otherwise specified. The conduits shall be joined with PVC adhesive at Joints. The Conduits shall be fixed to walls/ceilings with GI spacers and saddles at an interval of 45 cms & on either side of bends, junction boxes, pull boxes etc., The number of wires drawn in the conduits shall be as per table 1. The point wiring shall be controlled as in (a) above. The wiring shall be done with 2 nos. of 1.5 sq.mm. (for Phase & Neutral) &1.5sq.mm. (for earth) PVC insulated, copper conductors, multi stranded and colour coded with green as earth and black for neutral.

The circuit main wiring shall be with 3 nos. of 2.5 sq.mm. PVC insulated, copper conductors, multi stranded wires laid from distribution board to switch board and the rate shall be included in the point wiring unless otherwise stated in the schedule of quantities. All other details shall be as per metal conduits.

C) CASING CAPPING/ TRUNK AND TRUNKLING

PVC casing shall be fixed to wooden partitions by means of screws spaced not more than 45 cms apart. Holes for fixing the PVC capping shall be done by drilling machine only and these holes shall be plugged with PVC plugs or grips to which the screws shall be fastened. Nowhere less than 1 inch PVC casing shall be used. All bends, tees, joints etc., shall be done in workman like manner with standard accessories. The number of wires in

PVC casing capping shall be limited to a fill factor of not more than 60%. The point shall be controlled by 5amp switch. The switch boards shall either be flush mounted with partitions or surface mounted or concealed mounted as per site requirements and as directed. The wiring shall be carried out as described in (a) and (b) above.

Casing Capping wiring shall not be done for concealed wiring & for wiring over the false ceiling work.

A.2. DISTRIBUTION BOARDS

This specification covers the design, manufacture, assembly, testing at works, supply, installation and commissioning of distribution boards at site.

The system and accessories shall be complete in all respects and any device not included specifically in this specification, but essential for proper operation of the equipment and also to meet statutory requirements shall deemed to be within the scope of the specification whether it is mentioned in the Technical Specification, or not.

If the vendor finds that it is required to undertake any work which is not sufficiently defined in this specification or discovers that this specification conflicts with any other codes, standards and regulations which shall be required to comply, the same shall be clarified in writing from the Owner/Consultant before undertaking the work involved for avoiding the delay.

These shall be of sheet metal and of standard design with copper bus bars. The board shall be fixed at accessible heights. The boards shall be solidly fixed on MS brackets to walls/partitions, concealed or open as directed. All connections inside the distribution board shall be neatly arranged and tied with PVC strings. The MCB's shall be of 9KA for fault level. The distribution boards shall be suitably earthed. Legend shall be written on DB with paint for identification of DB & Circuits.

A.2.1 CONSTRUCTION

The distribution boards shall be fabricated out of 14/16 swg CRCA sheet steel, metal clad, totally enclosed dust damp and vermin proof, dead front, hinged door type of bolted/welded construction suitable for wall or floor mounting.

A.2.2 BUSBARS

The busbar shall be air insulated and made up of high conductivity high strength aluminum or copper busbars liberally sized with high safety factor for the required rating. The neutral busbars shall have adequate number of terminals for all number of outgoing single-phase circuits and the holes shall be suitable for multi strand wires. In the same way suitable earth bus shall be provided inside each distribution board for earthing of the lighting/power circuits and also earthing of distribution board. In the case of 3 phase distribution boards used for single phase outgoings, three independent neutral bars shall be provided.

A.2.3 MINIATURE CIRCUIT BREAKERS

Miniature circuit breakers (MCB) shall be of heat resistant, moulded type designed, manufactured and tested as per IS-8828.

The MCBs shall have inverse tripping characteristic against overloads and instantaneous trip against short circuits. The MCB shall be of fault current limiting device also.

The MCB shall be slip on type to the DIN rail. The ON & OFF positions of the switch handle shall be clearly marked. The MCB shall be suitable for operating in an ambient temperature of 45 deg centigrade without derating. The MCB shall be suitable for 415V, 3 phase, 415Volts, 50Hz system with a fault level of 9-10KA (rms) symmetrical. The terminals of MCBs shall be suitable for use with eye lugs. The 4 pole, 3 pole and 2 poles MCBs knobs shall be trunked with adequate strength tandem pin.

Each distribution board shall have individual hinged/bolted gasketed doors with suitable screws. Removable conduit entry plates shall be provided at top and bottom of the DB to facilitate drilling the conduit holes at site to suit individual requirements or knock out shall be provided.

Protective hylem / bakelite insulated cover plate shall be provided inside the panel to shroud all the live parts. Only the operating handle of the switch and the operating knob of the miniature circuit breakers shall be projecting outside the cover plate in case of ordinary IP20 DB and shall be inside the front door in case of dust tight IP42 DB. The unused outgoing holes / knockouts / cutouts of DB shall be suitably blanked with PVC plates at no extra cost. The incoming switch terminal should be suitably shrouded to avoid accidental contact. Each outgoing in the MCB DB shall have shrouding between Phases. The distribution board shall be factory wired and assembled and local fabricated DB shall not be accepted.

For TPN Distribution Board, four pole isolators shall be provided as incomer. For single phase and neutral Distribution Board, double pole isolator / ELMCB shall be provided as incomer. Earth leakage circuit breaker(s) to be provided wherever called for.

Suitable labels shall be provided to mark the circuit numbers of outgoings circuits.

Wiring Diagram shall be provided inside the DB.

A.2.4 EARTHING

The DB's shall be provided with two numbers of brass earthing terminals with suitable nuts, washers, etc., for connecting to earth bus. The Earth terminals shall be brought outside the DB. In case of flush mounting DB, these shall be provided inside the DB.

A.2.5 PAINTING

The DB sheet steel surface shall be chemically cleaned to remove scale etc., rinsed dried and shall be finished with two coat of powder coat paint over two coats of red oxide / epoxy zinc primer.

A.2.6 TESTS

All necessary factory routine tests shall be performed on the equipment before dispatch. The test results shall be sent along with the supply of DB.

A-03. CABLES

Cables shall confirm to IS 1554-1976. Cables shall be heavy duty, armored, PVC insulated &PVC sheathed 1.1 KV grade aluminum or copper. Cable shall be fixed with GI spacers & saddles at an interval of 30/45 cms and on every side of bends. The bending radius of cables shall be as per manufacturer's instructions and in no case, it shall be less than 12 times the overall diameter of the cable. Cable shall be so installed that they are not subject to any mechanical damage. If there is a bend in the cable enclosed in a conduit, care has to be taken to prevent undue compression of insulation. This applies also to the top of vertical runs of length longer than 5 meters where there could be compression caused by the weight of unsupported vertical cables. Cables may rest without fixing in horizontal runs or ducts or trunkings. The cables run in cable trays shall be fixed with cable ties at intervals of not more than 30 cms. No joints in the cables shall be permitted unless the cables exceed the standard drum length. Joints, if so necessary shall be located in accessible position. Termination of the cables shall be done with heavy duty copper/Aluminum lugs and brass cable glands.

Cables laid underground shall be to a minimum depth of 750 mm. It shall be ensured that cables laid underground are free of water lines, sewage lines etc. The trenches shall be at least 30 cm wide & filled with 10 cms thick of layer of dry sand on which the cable shall be laid. Further, 10 cms thick sand layer shall be put on the cable over which a brick layer shall be provided. The trench shall than be back filled with soft earth, rammed and consolidated to its original level. Cable route indicators shall be laid at intervals of 15 meters and at all change in directions.

For cables laid on walls aluminum tags shall be fixed showing the size of the cable and the feeder number of the cable. These tags shall be provided at each end and at least one or two places at intermediate positions.

The mode of measurement of the cables shall be as follows:

i) For top entry of the cable, the measurement shall be taken up to the bottom of that switch- gear.

ii) For bottom entry of the cable, the measurement shall be taken up to the top of that switch board. No wastage shall be allowed for measurements.

A-04. SWITCH FUSE UNITS

Switch Fuse Units shall be of sheet metal or iron clad with HRC fuses as described in schedule of quantities. The unit shall be of robust construction of standard specified make, design to withstand adverse working conditions. It shall have quick break type mechanism with ON and OFF position indicators of the operating handle. The switch shall be interlocked so that the unit cannot be opened in ON condition. The interior shall be so arranged that clearances from live parts are adequate and shrouded. Manufacturer's instructions shall be followed for installation of switch fuse units. The switch shall be solidly earthed. The switch shall be mounted on walls on angle iron support grouted to wall. The supports shall be treated for rust treatment & painted with 2 coats of synthetic enamel paint. The height of the switch board shall be such that it is accessible for operation & maintenance.

A-05. POWER PANELS

The Power panels shall be fabricated from MS sheet steel 14/16 gauge and shall be of compartmental design. The main supporting framework shall be of angle iron or of heavier gauge sheet metal. The panel shall be self-supporting design, dust and vermin proof, dead front and fully interlocked with isolating switches. The panel mounted switches shall have Interlock defeat arrangement for testing and inspection.

The panel shall be designed so as to facilitate inspection, cleaning and repairs. The clearance between phase to phase and phase to earth or metal parts shall be as per relevant IS standards. The metering instruments like voltmeter, ammeter etc. shall be flush mounted and shall be of 1.0 class accuracy and of standard design size of 96 mm x 96. All indication lamps shall be of neon /LED type.

The busbars shall be air insulated and made up of high conductivity, electrolytic aluminum / copper bars complying with the requirement of IS 5082:1981 and shall have a fault withstand capacity of 50 KA/1 Sec. All busbars shall be fully screened by means of PVC heat shrinkable sleeves in their own compartment running throughout the length of the Panel. Suitable allowance should be made for bus expansion.

The panel shall have separate cable ally and a bus bar chamber. The bus bars shall be rigid hard drawn tinned electrolytic copper wherever specified & sleeved with heat shrinkable sleeves. The current density shall not exceed 1.25 amp per sq.mm and the neutral bus shall be rated for capacity of phase bus unless otherwise stated in schedule of quantities/drawings. However, the minimum size of bars shall be 25mmx3mm. Minimum electrical clearance shall be maintained between phases, neutral and body as per IS 4237:1982.All outgoing feeders shall have neutral link of appropriate capacity at cable termination end. For Incomers as MCCBs wherein cable is directly connecting at switchgear end the neutral link to be mounted adjacent to switchgear.

The panel shall be powder coated comprising of degreasing and de-scaling in sulphuric acid etc. with synthetic enamel paint for smooth finish. The color of paint shall be battleship grey or as directed. The Panel shall be tested at site before commissioning. The Panel drawings shall be got first approved from Consultants before taking up for fabrication.

All wiring inside the panel shall be done with switchboard copper conductors/cables and/or with solid copper links. The insulators for supporting the Bus-Bars shall be epoxy based cast resin. All hinged doors shall be earthed with flexible braided copper earth. An earth bus of copper shall be fixed along the length of the panel at the lower section. Adequate ventilation for the panel shall be provided. Logic diagram of operation of switches shall be painted on the panel. The name plates for each feeder shall be of engraved design and pasted to the respective switch gear. The letters shall not be less than 10 mm size for individual feeders and not less than 18 mm for the main feeders. All switchgear to be mounted in the panel shall be as per schedule of quantities.

A-06. EARTH PITS/STATION

The Earthing station shall be done as per IS 3043 (1981) and as per drawing no. E1. The earth pit shall be at least 2.5mtrs deep with CU/GI Plate electrode. The GI plate electrode shall be hot dipped of 600x600x6 mm thick. The size for copper plate electrode shall be

600x600x3mm thick. An alternate layer of salt and charcoal shall be filled up to 200 mm above the top of the electrode. The electrode shall be connected with 32x6 mm thick GI Flat (for copper earth electrode size of flat shall be 25x3 mm) which shall be terminated with nuts and bolts into brick masonry chamber on top. The brick masonry chamber shall be of size 300x300x450mm deep which will carry the funneling arrangement for watering. A GI Flat of 32x6 mm from brick masonry chamber to the switch gear inside the switch room shall be laid underground and/or fixed to walls. The rate for laying GI/ CU strip from earth pit to switch room shall be paid under separate item.

All the main earth conductor above the ground level shall be painted with two coats of enamel paint. The following colour codes have to be followed:

(a) Main body earth bus	-	Green colour
(b) Main neutral earth bus	-	Black colour
(c) Lightning protection earth bus	-	Red colour or as preferred by Owner/Consultant.

Earthing system of equipment earthing, neutral earthing, Data Networking earthing and lightning protection earthing should not be mixed together above the ground. These systems/connections shall be tested in accordance with IS 3043-1987. Earth resistance of the individual system shall be measured after connecting all the electrodes to the bus and the combined value shall be less than 1 ohm (One ohm).

A-07. INSTALLATION OF ELECTRIC FITTINGS

All electrical fittings shall be fixed with down rods or on round blocks as stated in schedule of quantities. The down rods shall be of 19/20 mm dia. and with 1.6mm wall thickness of ERW black enamelled MS or GI. The down rods shall be fixed with ball and socket joints, check nuts etc. Special fixtures like spot lights etc.; shall be fixed to the false ceilings as per manufacturer's recommendations. The fittings shall be connected with 3 core 0.5 sq.mm flexible copper cord/cable from ceiling rose and suitable earthed.

A-08. POWER FACTOR CORRECTION PANEL

The power factor correction panel shall be fabricated from sheet steel & powder coated. The panel shall be compartmentalized with tinned copper bus bars TP as described for power panels.

The power capacitors shall be APP type, low loss, 3 phase, delta connected & self-discharged type.

The power factor control shall be done by automatic power factor control relay for controlling the power factor within the set limits by auto switching of required capacitor Banks. The required Capacitors / PF Banks shall be as per schedule of quantities. The P.F. shall be automatically corrected to near Unity.

The C.T. ratio given in the Schedule/diagram is indicative. The same shall be matched for correct operation depending upon the operating load. The relay shall be totally microprocessor based for setting the desired target power factor band. The APFC relay shall have indications like power ON, low current etc.& shall be of required stages as per schedule of quantities. The P.F Panel shall have Auto Manual switching facility.

The general specification shall be as follows: i) System supply voltage 415 volts.

ii) C.T. secondary rating 5A, 5VA Burden.

iii) Output switching capacity 5A at 230 V AC & 2A at 440V AC, Operating temperature 10 degree Centigrade to 50 degrees Centigrade. Accuracy better than 1%. Low current release 10% of full rated C.T. iv) Switching time between stages 4 to 6 seconds.

v) Range of indications of PF 0.5 lag to 0.5 lead digital.

vi) Display LED indications. vii) Range of target P.F. setting 0.7 to 0.99. viii) Switch for auto/manual operation. ix) Indications for selection of stages. x) Selection of dead band.

A-09. TESTING OF ELECTRICAL INSULATION

The following tests shall be carried out during execution and after completion of the electrical installation work.

1) Insulation Resistance Test.
2) Polarity Test of Switches.
3) Earth Continuity Test.

1) Insulation Resistance Test: The insulation resistance shall be measured by applying between earth and whole system of conductors or any section thereof with all fuses in place and all switches closed (except in earthed concentric wiring) all lamps in position & both poles electrically connected together, or direct current pressure of not less than twice the working pressure, provided that it need not exceed 500 volts for medium voltage circuits, be applied. Where the supply is derived from 3 wire DC or Poly phase A.C. System, the neutral pole of which is connected to the earth either direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured in mega-ohms between all conductors connected to one pole of phase conductor of the supply and all the other conductors and switches in off position it's value shall be not less than as specified below:

The insulation resistance measured in mega ohms shall not be less than 50 mega-ohms divided by the number of outlets or when PVC insulated cables are used for wiring, 12.5 mega-ohms divided by the outlet subject to a minimum value of 1 mega-ohm.

A preliminary and similar test may be made before lamps etc. are installed and in this event the insulation resistance to earth shall not be less than 100 mega ohms divided by the number of outlets or when PVC insulated cables are used 25 mega ohms divided by the number of outlets subject to a minimum of 1 mega ohm.

2) Polarity Test of Switches: In a 2-wire system a test shall be made to verify that all switches in every circuit are fitted in the same conductor throughout and such conductors shall be labeled or marked for connection to the phase conductor or to the non-earthed conductor of supply.

In a 3 wire or 4 wire insulation a test shall be made to verify that every non-linked single pole switch is fitted in a conductor which is labeled or marked to one of the phase conductors of supply.

3) Earth Continuity Test: The Earth Continuity Conductor including metal conduits and metallic envelopes of cables in all cases shall be tested for electric continuity and electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit breaker measured from connection with earth electrode to any point in the earth continuity conductor in the completed insulation shall not exceed 1 ohm.

TECHNICAL SPECIFICATION OF TESTING AND COMMISSIONING

The scope of work for testing and commissioning of the total installation shall be for the capital equipment like transformers, switchgears, cables etc., and also for the associated equipment like relays CTs, PTs, etc.

The scope of work for testing and commissioning of electrical equipment for the above shall include but not be limited to the following:

e) Providing sufficient number of experienced Engineers, Supervisors, Electricians so that the installation can be commissioned in stipulated time.
f) All the instruments, tools and tackles required for carrying out the testing and commissioning shall be provided by the bidder.
g) The testing of electrical equipment shall be carried out as per the relevant Indian Standards/Code or Practices/Manufacturer's instructions.
h) Cleaning of electrical equipment, contacts cleaning and greasing etc. All the equipment and material required for above shall be supplied by the bidder.
i) Connecting the panel/equipment wiring for proper functioning of the schemes required/called for.
j) Installation and wiring of additional equipment on panels like auxiliary contactors, timers, etc. which may be additionally required for proper functioning of the schemes.
k) Checking of equipment earthing and system earthing as a whole.
l) Testing of all the cables.
m) Co-ordination with other contractors for testing and commissioning of interface cables.

TESTS TO BE CONDUCTED

1. All tests shall be performed in the presence of the bidder and customer/consultant. For all types of visual inspections, checking, pre-commissioning, commissioning test and acceptance tests, IS Code to be followed for the tests given therein in addition to the instructions in this technical specification. The intention of giving the few test procedures, described below, is to provide a guideline for the bidder. However, bidder shall not restrict themselves in carrying out only the tests described in this document.
2. Bidder shall submit their proposed test procedures for approval and shall not commence testing such approval is given.
3. Bidder shall check and test all electrical equipment and systems installed and supplied them, including equipment supplied by the Owner.
4. Bidder shall supply all necessary test equipment and personnel both craft and supervisory category to carry out the work without danger to personnel or damage to equipment.
5. Bidder shall ensure that no tests are applied which may stress equipment above the limits for field testing recommended by the manufacturer. Bidder shall be responsible for any damage to personnel or equipment resulting from improper test procedure.
6. All defective materials furnished by the bidder and defects due to poor workmanship revealed through field testing, shall be corrected at bidder expense without affecting the completion of the project.
7. Client/Consultant reserves the right to interpret and approve all test results prior to energization of circuits or apparatus.
8. Bidder shall visually inspect all equipment for defects immediately upon arrival at site including those supplied by the Owner.
9. Relay coordination chart and final setting before/commissioning.

MECHANICAL CHECKOUTS

After installation, but before any power supply is connected, the contractor shall make a complete mechanical check of all installed electrical equipment and systems. This shall include but not to be restricted to the following:

- Check equipment numbers against drawings/documents.
- Check name plates of transformers, switch gears etc., for conformity with the data given in the drawings and specifications.
- Check all equipment bus joints and connections for tightness.
- Check all cable and wire connections for tightness.
- Check phase sequence.
- Check all bushings/insulators to ensure they are clean and unchipped. Inspect tank cooling tubes and radiators for leaks.
- Check silica gel for dryness where breathers are supplied. If the colour of the silica gel is pink, remove from the breather and dry out following manufacturer's recommended procedure, until a light blue colour is restored and then replace it.
- Check valve in the connecting pipe between the conservator and transformer tank to ensure that valve is in 'open' position.
- Check interlocking on access doors for mechanical and electrical safety. Check that key and electrical interlocking system functional and accomplish their purpose.
- Check all plug-in contacts for alignment and 'grip'.
- Check all contactors for free manual operation.
- Remove all locking devices installed for shipment.
- Check all the coils for their continuity and proper voltages.
- Check the arc chutes, arcing horns, main contacts of breakers are clean and undamaged. Check the carriages ride smoothly and reliably on their guide-rails. Check for proper operation of circuit breaker operation mechanism, controls and adjustments.
- Check for the fuses whether correctly rated and installed, undamaged and fit for operation.
- Check all relays and instruments are clean, correctly connected and undamaged. Check test plugs are installed in all protective relays. Check relays for free manual operation, if applicable.
- Check instrument transformer ratings against drawings. Check for proper installation and connection.
- Check interlock and auxiliary devices and the operation of the circuit breaker with the protection relay circuit.
- Clean the equipment by vacuum cleaner before energizing.

EARTHING

1. Bidder shall test the buried earth grid and shall record the values.

2. Bidder shall inspect and test all earthing work carried out by him, including all interconnections between ground loops, grounding of equipment and ensure all connections are permanent and that the earthing circuit is continuous.

3. Bidder shall megger and record earth resistance at various earth connection points.

SWITCHGEAR

- Switch gears rated 433 volts or more shall be tested with a 1000 volts megger.

- Auxiliary wiring rated less than 415 volts shall be tested with a 500 volts megger.

- All protective relays shall be tested at sufficient points to establish their proper functioning in accordance with the manufacturer's specification and curves.

- Operation checks and functional checks on all switchgear panels.

- For current transformers insulation test, polarity test, ratio test, secondary injection test, operating current check, service setting in consultation with Client / Consultant.

- For potential transformers, ratio test, insulation test, etc.

- Contact resistance for breaker contacts between male and female.

WIRES AND CABLES

- Continuity testing of all cables.

- Wires and cables rated for 433 volts or more shall be tested with a 1000 volts megger. Cables rated less than 433 volts shall be tested with a 500 volts megger.

- No wires or cable having resistance between conductors or between conductors and ground of less than 100 mega-ohm shall be accepted.

FUNCTIONAL TESTING

1. All circuit breakers, contactors, relays, remote devices, etc.,

PRECOMMISSIONING TESTS

- All pre-commissioning tests stated as per IS for respective items

TECHNICALSPECIFICATIONS

1. Main Low Voltage Switch board Enclosure

This section covers the detailed requirements of Main Low Voltage Switch board for 415 volts, 3phase, 50 Hz, 4 wire system.

STANDARDS AND CODES

The equipment proposed in this offer has been designed, manufactured, and tested according to the relevant IEC recommendations.

- IEC61439-1/2–Edition 3 Low voltage switchgear & control gear assemblies–Part 2 Power switch gear and control gear assemblies
- IEC60044-1Current transformers
- IEC60186 Voltage transformers
- IEC60529 Degrees of protection provided by enclosures
- IEC60947-2Lowvoltageswitchgear&controlgear–part2Circuitbreakers
- IEC60947-3Low voltage switchgear & control gear–Part 3 Switches, disconnectors, switch- disconnectors & fuse combination units
- IEC61140 Protection against electric shock–Common aspects for installation and equipment–Basic safety publication
- IEC60947-4-1Contactors and motor starters

General

The LV switchboards shall be as per the standards IEC 61439-1&2. The switchboards and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, Busbar links etc shall be identical in construction to the assembly which has undergone the type test. The drawings of the type-tested assemblies shall be made available for inspection.
Switch boards shall have a short-circuit level with stand as per Schedule of Quantities and drawings.

The enclosures shall be designed to take care of normal stress as well as abnormal electro- mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 42 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 42 is retained.

Switch boards must have mechanical impact IK10 tested.
The switchboard along with ACB sand connections should have been type tested design at CPRI /Independent international test house for short-circuit, temperature rise, protective earth short circuit test and dielectric tests of the ratings required.

Refer SLD for form of construction.

Switchboard Configuration

The Switch board shall be configured with Air Circuit Breakers, MCCB's, MCB’s and other equipment as called for in the schedule of quantities.

The Switchboards shall have Rated Impulse withstand voltage (Uimp) of 8kV for withstanding against transient Over voltages, for which the values of clearances are referred applicable for ACB, vertical and horizontal busbars.

The MCCBs shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single tier formation only to facilitate operation and maintenance.

The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

Constructional Features

The Switchboards shall be metal clad totally enclosed; floor mounted freestanding type of modular extensible design suitable for indoor mounting.

Switch boards construction shall employ the principle of compart mentalized and segregation for each circuit.

Incomer and bus section panels or sections shall be separate and independent and shall not be wired with sections required for feeder. The incomer panel shall be suitable for receiving bus trunking or LV cable of size specified.

Switch boards shall be made up of requisite vertical sections, which when coupled together, shall form continuous switchboards.
Switchboard shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.

The switchboards shall be designed for use in high ambient temperature and humid tropical conditions as specified. Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

Special care to be taken to ensure effective earthing of the frame and doors of the switchboards

Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequate safety for working in one vertical Section without coming into contract with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.

The complete fabrication process of the sheet steel must be carried outby bidder.

Switchboard panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness, same as that of tested assembly according to IEC61439-1 & 2.

Switchboard Dimensional Limitations

The overall height of the switchboard shall be limited to 2100 mm for all the Busbar ratings and type of switchboards. Panel should have integral base frame of 75/100mm,

The height of the operating handle, push buttons etc shall be restricted between 300 mm and 1800 mm from finished floor level.

Other dimensional limits if any are specified separately.

Switchboard Compartmentalization

Switchboard design shall be completely compartmentalised with separate compartments for horizontal busbars, vertical busbars, Cable alleys and functional units consisting of ACBs, MCCBs, & MCB's.

Earthed metal or insulated shutters shall be provided between draw out and fixed portion of the switchgear such that no lives parts are accessible with equipment drawn out. Degree of protection within compartments shall be at least IP 2X.

For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.
Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be in front of switchgear only.

Separate cable compartments running the height of the switchboard in the case of front access boards shall be provided for incoming and outgoing cables.

Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley / cable chamber.

Switchboard BusBars

Busbars shall be made of high conductivity, and high strength Aluminum E91 grade.

Busbars shall be of rectangular cross sections better suitable for full load current for phase bus bars and half/full rated current for neutral busbar or as stipulated in schedule of quantities.
Busbar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities.

The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar alloy on either side in which the circuit could be arranged with front access for cable entrances.

The Busbar Support and the spacing should be same as per the type tested assembly. Clearances between

phases should be in line with IEC.

Switchboard Interconnection

All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.

For unit ratings upto 160Amps, PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped.

All connections, tappings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with. even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silveredto maintain good continuity at all joints. All screws, bolts, washers shall be zinc plated. Only 8.8 grade nuts and bolts shall be used for busbar connections.

Smart Wireless Sensors (Cable Heating Detection)

Thermal monitoring wireless sensors shall be fitted at least on LV field cable connections and ACB connections (upstream and downstream) as well as bolted copper connections. The monitoring shall be done by a battery less sensor that communicates wirelessly using Zigbee Green Power protocol. The corresponding gateway and EPMS Software should be considered in offer while quoting. Equivalent to TH110, PME and PAS600 of Schneider.

Switchboards, non-forced air ventilated, shall be enabled with a DIN rail wireless sensor capable of monitoring the system and generate three-Levels of alerts on overheating wire connections or overheating cables depending on the severity of the detected situation.
Each column of the electrical switchboard shall include one wireless sensor at the top, to help user to prevent electrical switchboards from being damaged, by analyzing gas and particles in the air and sending alerts before any smoke or insulator browning occurs.

Sensor shall be able to analyze gases and microparticles inside the switchboard, by concentrating air into the sensor (with the help of an aspiration fan), applying a smart algorithm to sort internal cable issues from overheating, and sending alerts via email or notification to a smart phone application, enabling the switchboard's digital management.

Temperature and humidity inside the switchboard should be measured by the wireless sensor and values to be communicated through the network. Wireless sensor for early detection of overheating wire connections or overheating cables, should fulfill ISO 14025 PEP eco passport ® program requirements.
Sensor device should not replace any fire protection device of the installation.

Draw out Features for ACB

Air Circuit Breakers shall be provided in fully draw out cubicles, unless otherwise stated. These cubicles shall be such that draw out is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

Instrument Accommodation/Meters

All voltmeter and ammeter and other instruments shall be flushed mounted type of size 96 sq. mm conforming to class 1.5 to IS1248 for accuracy. All voltmeter shall be protected with MPCBs.
Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard.

For MCCBs, instruments and indicating lamps can be provided on the compartment doors.

The current transformers for metering and for protection shall be mounted on the solid copper/aluminium busbars with proper supports.

On all the incomers of switch boards ON/OFF indicators lamps shall be provided suitable for operation on AC 230 volts supply. All lamps shall be protected by MCBs.

Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrulesfor identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means

shall be provided for easy identification of wires. Identification ferrules shall used at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.

Space Heaters

Anti-condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50Hz single phase of sufficient capacity to raise the internal ambient temperature by 5OC. The electrical apparatus So protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a general rule, the heaters shall be placed at the bottom of the cubicle.

Earthing

Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to station earth at two points. Hinged doors / frames to be connected to earth through adequately sized flexible braids.

Sheet Steel Treatment and Painting

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process after which a coat of primer paint with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50 micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.

Type test reports

Switchboard configurations offered shall be CPRI /Independent international test house tested for all the 12 type tests as per IEC61439-1&2. Copies of all 12 type test reports shall be submitted with the tender.

Air Circuit Breaker The ACB shall have following features

- ACBs shall be a sealed low voltage air circuit breaker operated as specified on the drawings with integrally mounted electronic trip units with option to add communication port.
- Circuit breakers shall have a maximum 5-cycle closing time. The closing time shall be less than or equal to 50 milliseconds for ratings <800A;70 milliseconds for ratings <4000A; 80 milliseconds for ratings >4000A
- ACB shall be equipped with anti-pumping function: If opening and closing orders occur simultaneously, the circuit breaker shall remain in the open position. After fault tripping or intentional opening using the manual or electrical controls, the closing order must first be discontinued, then reactivated to close the circuit breaker.
- ACB shall not derate upto 50’C, as per testing guidelines prescribed in IEC60947-2.
- All ACBs up to 2500A shall be of same frame size to enable quick replacement in the event of emergency and to optimize spares inventory.
- All 4 Pole ACBs shall have 100% rated neutral pole.

- All EDO type ACBs shall indicate Ready-to-Close status of breaker (mechanically on front of ACB or electrical indication lamp of panel front door), after checking all the given conditions (UV release energized, Shunt release de-energized, spring charged, Breaker is not "ON", Breaker has not tripped on fault, Breaker is not mechanically interlocked with other
- Breaker and ACB is not racked incompletely in service position)
  ensuring safety for user and electrical distribution.
- All ACBs shall be fully tropicalized as standard & suitable for terminating copper or aluminum bus bars. ACBs up to 2500A shall be provided with top horizontal and bottom vertical terminal adapters on both sides for proper cable connections/bus duct connections. ACBs rated for 3200A and above, shall have both side vertical terminal adaptors for effective heat dissipation and better thermal performance.
- All ACB trip unit shall be possible to view the percentage loading of three phases at once on trip unit via LEDs or LCD display to help the user in identifying the current load balancing of the network.

ACB-Breaking Capacity

The ACB interrupting rating shall exceed the available fault current.

The ACB range will offer several level of Icu capacity upto100kA@415V to fit to the application. (for 2MVA< Traffo </=3MVA) ACB
shall have the breaking performance Ics=Icu=Icw1sec=65kA) or (for </=2MVATraffo) ACB shall have the breaking performance Ics=Icu=Icw1sec=50kA).

- The ACB shall be available in 3-pole or 4-pole (neutral protection) versions. On 4-pole circuit breakers, a 3-position switch shall be provided to set neutral protection to any of the following levels: unprotected neutral (4P3D), half-protected neutral (4P3D+N/2) or fully protected neutral (4P4D).
- The trip units shall not increase overall circuit breaker dimensions
- All electronic components shall withstand temperatures upto 105°C.
- Trip units shall be adjustable for settings and fine settings without specific tool.
- Trip units shall have traceability of settings.
- Trip units shall provide native ERMS (Energy Reduction Maintenance settings) function for safety protection.
- Engaged status of ERMS shall be visible at a distance.
- Protection settings shall apply to all circuit breaker poles
- Electronic trip unit shall be fitted with thermal memory
- It shall be possible to equip ACBs with an auxiliary contact signalizing an electrical fault operatedby the trip unit
- The following monitoring functions shall be integral parts of electronic tripunits:

  o Pre Warning LED for load indication lighted above 90% of the adjusted threshold Ir

  o Warning LED for load indication lighted above 105% of the adjusted threshold Ir
- Trip units shall have communication/test port for checks on electronic and tripping mechanism operation in

compliance with market standards (USB-C) avoiding require specific Manufacturer's hardware additional tool

- Trip units shall have native NFC wireless communication for protection reading with smart device. Dedicated Bluetooth communication version provides protection settings.

Trip unit protection functions

ACB shall be equipped with a trip unit that offers the appropriate level of performance to fit to the application:

Basic protection (LI) with energy measurement These trip units shall offer

- **L**ong time protection
- Adjustable Ir(A)threshold settings from 40% to 100% of the trip unit rating - Adjustable tr(sec) time delay
- **I**nstantaneous protection
- Adjustable Isd(A) threshold settings from 1.5xIr to10xIr

Selective protection (LSI) with energy measurement

- These trip units shall offer - Long time protection
- Adjustable Ir(A) threshold settings from
- 40% to100% of the trip unit rating
- Adjustable tr(sec) time delay
- **S**hort time protection
- Adjustable Isd(A) threshold settings from 1.5xIr to10xIr
- Adjustable tsd(sec) time delay - **I**nstantaneous protection
- Adjustable Ii(A) threshold settings from 2xInto15xIn with an OFF position - Specific setting for fast breaking time:30ms

Selective protection & Ground fault (LSIG) with energy measurement

The trip units shall offer

- Long time protection
- Adjustable Ir(A) threshold settings from 40% to 100% of the trip unit rating
- Adjustable tr (sec) time delay
- Short time protection
- Adjustable Isd(A) threshold settings from 1.5xIr to10xIr

- Adjustable tsd(sec) time delay
- Instantaneous protection
- Adjustable Ii(A)threshold settings from 2xInto15xIn with an OFF position
- Ground fault protection(GF)
- Adjustable Ig(A) threshold settings
- Adjustable tg(sec)time delay
- Option to set OFF the ground fault protection (GF)

Trip unit measurement function

The trip unit shall provide measurement (at least current / at most energy) without any additional module whatever the protection (LI, LSI, LSIG).

- Rogowski current transformers shall be used to ensure accurate measurements from low current up to high currents
- All protection functions shall be ensured by an ASIC (Application Specific Integrated Circuit), independently of measurement function.
- The measurements shall be displayed on the breaker itself, on a remote system via Modbus communication and locally by means of smart device using wireless protocol (Bluetooth). In addition to these solutions it shall be possible to connect a remote display (front panel).

ACB-Protection Type

Instantaneous settings on the trip units with LSI protection shall be adjustable from 1.5 to 15 xIn. The Instantaneous settings hall also have an OFF setting when short-time pick-up is provided. Long time over current protection threshold shall be adjustable from 0.4 to 1 x ln. Long time over current protection time delay shall be adjustable from 12.5 to 600sat1.5xlr,
0.5 to 24s at 6 x lr and 0.7 to 16.6 x lr. Short time overcurrent protection threshold shall be adjustable from
1.5 to 10 x lr and short time overcurrent protection time delay shall bead justable from 10 to 40ms of I2T.
Ground fault protection shall be adjustable.

ACBs shall have separately powered, individual fault trip indication LEDs (For overload, short circuit, earth fault and trip-unit failure) shall be available on the trip unit which shall function even in the absence of external power supply to the breaker.

All ACBs in main LT panel shall be provided with zone selective interlocking which helps in reducing the thermal and dynamic stress on installation during short circuit and ground faults. The releases shall be suitable to communicate between incomer breaker and outgoing breakers enabling zone selective interlocking.

The trip unit shall be a Micrologic6 from Schneider Electric, equal and approved.

ACB-Release Functions

ACB-Release with Metering, Protection

& Communication functions. **ACB- Connectivity** The main incomer shall be with RS485MODBUS connectivity.

Standalone Metering - Incomer Multi-function Meter

The power meter shall measure the following parameters: Energy, Active and Reactive power, Voltage, Current, Frequency, Power Factor and THD to the 31st harmonic (Over Communication). Power Meter (PM) needs to comply to Active energy accuracy of Class 0.5S as per IEC 62053-22. Relevant type test documents tested in third party lab to be produced. Power Quality Meter (PQM) needs to comply to Voltage, Current, Active Power, Power Factor, Frequency as per IEC 61557-12.5. Power Meter (PM) needs to be capable of storing 12am Snapshot (Time Configurable) for Voltage, Current, Power, Energy delivered and capable of retrieved during the 24 hours of the day. Power Meter (PM) needs to be capable of inbuilt 02 energy counters for KgCo2 and Energy Cost. 6. Power Meter (PM) needs to be inbuilt with Calibration Pulse LED configurable from 1 to 9999000 pulses/k_h (kWh, kVAh, or kVARh) unauthorized access and Heart beat LED for communication Status. 9. Power Meter (PM) needs to be capable of onboard data logging up to 2 parameters with option to select from Power (W,VA,VAR) Bi-directional energy (+/-Wh, +/- VAh, +/- VARh), Demand
(W, VA,VAR) with configurable interval and duration (e.g. 2 parameters for
60 days at 15 minutes interval). Power Meter (PM) needs to needs to have RS 485 port Modbus RTU and disabling RS485 port through front panel keys against unauthorized access.

The meter shall be a PM2230 or equal and approved (Refer SLD).MCCBs **The MCCB shall have following features**

- MCCBs shall comply with standards IS/IEC60947-1&2.
- The breaking capacity performance certificates shall be available for category A to the above- mentioned standards.
- MCCB shall have a rated operational voltage (Ue)of 415V,insulation voltage (Ui) of 690V (AC 50/60 Hz) & impulse voltage (Uimp) of not less than 8kV.
- MCCB shall not have any line load bias. MCCB shall comply with the environmental directives like RoHS and WEEE.
- MCCBs shall be current limiting type and shall have an encapsulated double break roto design having two fixed contacts, one moving contacts and two arc chutes per pole.The design is required to minimize the effects of short circuit currents i.e. to limit the let through energy and improve the life of cables. It shall be possible to fit lead seals to prevent unauthorised access to the settings. MCCB's shall have push to trip function for checking the tripping mechanism healthiness. Also this checking shall be possible with or without rotary handle.
- MCCBs up to 200A shall be thermal magnetic type, above 200A shall be microprocessor based type.
- MCCBs accessories (Shunt Coil, Auxilary Contacts, UV Coils, etc.,) shall be considered asper SLD.

MCCB s-Type MCCBs shall be fixed type.

MCCBs-Breaking Capacity

The MCCBs shall have a rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) at 415V and as per system fault levels (refer SLD). Switchgear Manufactures can optimize breaking capacity of outgoing breakers (MCCBs, MCBs)by using cascading technique as defined in IEC 60947-2 Annx. A. Switchgear manufacturer shall submit necessary backup documents and Cascading reports along with techno-commercial offer.

MCCBs-Protection Type

Adjustable thermal protection from 0.7 to 1.0x the current rating. Fixed magnetic protection for current ratings up to 200 A. Adjustable (from 5 to 10 x the current rating) for current ratings greater than 200A.

Electronic Long-time protection will have a selectable Ir threshold rating. Short time protection Isd will have a threshold which shall be adjustable from 1.5 to 10 x the thermal setting Ir. Instantaneous protection will have a threshold that shall be adjustable starting from 1.5 x In and up to a value between 12 and 15 x In, depending on the rating. It shall be possible to adjust earth leackage setting min 30mA with adjustable time delay.

CODES AND STANDARD

The following codes and standards shall be applicable for continuous performance of all electrical equipment to be supplied delivered at site erected, tested and commissioned. The electrical Equipment offered shall comply relevant Indian Standard Specifications, Fire Insurance Regulations Tariff Advisory committee's Regulations and to Indian Electricity Rules in all respects with all its latest amendments up-to-date.

For guidelines to the Bidder few of the Indian Standards are indicated below: - IS 3043 - Code of

practice for Earthing
IS 10118 - Code of practice for Installation of Switchgear.
IS 3106 - Code of practice for selection installation and maintenance of fuse (up to 650 Volts) IS 3427 - Metal Enclosed
Switchgear and control gear.
IS 4064 - Switch fuse units for Industries etc.
IS 4237 - General requirement for Switchgears not exceeding 1000 volts. IS 4615 - Switch Socket Outlets.
IS 5133 - (Part I) Sheet Steel Boxes. IS 5216 - Guide for safety procedures and practice in electric work. IS 5578 - Guide for making of insulated conductors.
IS 5908 - Method of measurements of electrical installation in building. BS 162 - Electric power switch gear for indoor and outdoor Installations.
IS 374 - Ceiling Fans
IS 415 - Tungsten Filament Lamps. IS 694 - PVC insulated cable and cords for Power/Lighting. IS 732 -
Electrical wiring installation (up to 650 V)
IS 1087 - Single pole Tumbler switch 5 amps. IS 1293 - 3 Pin Plugs and Socket outlets.
IS 1554 - PVC insulated Cables - heavy duty. IS 1567 – Metal clad switches up to 100 Amps.
IS 1771 - Industrial Light fittings with accessories.
IS 6381 - Specification for constructions and testing of Electrical Apparatus. IS 2268 - Call Bells / Buzzers.

IS 2274 - Code of practice for wiring installations (exceeding 650 Volts). IS 3854 - Switches for Domestic and similar Purpose.
IS 2312 - Exhaust Fans.
IS 2509 - PVC Electrical conduits.
IS 2675 - Enclosed Distribution Fuse Boards and cutouts for voltage up to 1000 Volts. IS 2834 - L.T. Capacitors.
IS 3043 - Code of Practice for Earthing.
IS 1646 - Code of Practice for Fire Safety in Electrical Installation.

The entire electrical installation work shall be strictly complied with the codes and Standards. Rules and Regulations framed under the Indian Electricity Act 1910 and Indian Electricity Rules 1956. Further it shall be carried out as per the Regulations and Rules set out by "Tariff Advisory Committee and or / Fire Insurance Regulations.

M. V. SWITCH BOARD

SCOPE

1. This specification covers the design fabrication testing packing and supply of 415/230 volt, 3 phase 4 wire Indoor Fixed type compartmentalized cubicle type. Floor mounting switchboards.

2. The switchboard and mounted equipment shall comply with following Indian Standards:

    1. IS 2516 - AC Circuit breaker requirements voltage not exceeding 1000V.
    2. IS 2147 - Degrees of protection provided by enclosures for low voltage switchgears and control gear.
    3. IS 4237 - General requirements for switchgears and control gear for voltages not exceeding 1000V.
    4. IS 4047 - Heavy-duty air break switches and fuses for voltages not exceeding in 1000V.
    5. IS 2208 - HRC cartridge fuse links up to 650V.
    6. IS 2705 - Current transformers.
    7. IS 1248 - Electrical indicating instruments.
    8. IS 375 - Marking and arrangement for switchgears busbars main connections and auxiliary wiring.
    9. IS 159 - Busbars and Busbar connections.
    10. IS 8623 - Factories Built Assemblies Switchgears and Control gear.
    11. IS 1897 - Copper strip for electrical purpose.
    12. IS 3618 & IS 6005 Phosphate treatment of iron and steel.
    13. IS 2032 - Graphical symbol.

SPECIFICATION

A) The assembly shall be metal clad compartmentalized and shall comprise standard prefabricated sheet steel units. Assembled to form a rigid freestanding dead front structure Frame shall be made out of 14 gauge M. S. sheet steak and covers out of 16 gauge M. S. cold rolled sheet steel. Vertical units shall be assembled to form a continuous line-up of uniform height & depth. Switchgears shall be extensible at both ends by the addition of vertical sections. Ends of the busbars shall be suitable drilled for this purpose.

1. The switchboard shall be totally enclosed fully tropicalised weather and verminproof. Opening for screens or grills made of brass wire mesh. Double lipped. Neoprene gasket shall be provided on doors removable covers gland plants and between two vertical panels all round perimeter to make switchboard dust and vermin proof. Enclosure of the switchboard shall be IP 50 for indoor type as per IS 2147 Hinges should be concealed for aesthetic appearance.

2. The switchboard shall be suitable for operation in tropical climate and under ambient conditions specified.

3. All joints and connections shall be made by galvanized or cadmium plated high tensile strength steel bolts, nuts and washers secured against loosening.

4. The switchgears shall be designed to ensure maximum safety during operation inspection connection of cable and maintenance with Bursar system energized Means shall be provided to prevent shorting of power and or control terminals due to accidental dropping of maintenance tools etc Inside the switchboard i.e. M. S. Horizontal partition between feeder compartments between Bus bar chamber and feeder compartments vertical partition between feeder compartment sand cable alleys and between two vertical panels.

5. All equipment shall be mounted on the front side and shall be accessible from the front through hinged doors. Control and selector switches ammeters, voltmeters and lamps push buttons relays etc shall be mounted on doors Current Transformer will be mounted on bus bars.

6. It shall be possible to insert any new cable and to connect all load side wiring with the bus energized without any special safety precautions. Opening of the bursars chamber shall be permitted with special tools only.

7. Compartment doors shall be interlocked against opening when the breaker/ switch is ON position. However it shall be possible to bypass this interlock for inspection purposes.

8. The switchboard will be provided with metallic engraved labels on compartments as well as by switchboard designating Department/Section/feeder where in the said switchgears/ switchboard is used.

9. The switchboard will have removable type cable gland plate to facilitate termination/glanding of cables. The size of gland plates should be spacious and to be decided in such a way that tightening of gland is easily possible without disturbing other gland. So also distance between the cables should be sufficient to maintain clearances.

10. Sufficient space for cable alley to be provided to accommodate the number of cables. Necessary clearances between cables to be maintained. Arrangement for clamping mounting to be provided. Cable alley to be located in switchboard in such a way that after termination cables on switchgear tension will not be created on lug/terminals.

11. Base frame for switchboard will be of ISMC 100 rigidly welded to switchboard compartment.

12. Above the base frame compartments of min size of 300mm will be left vacant throughout the length of panel.

13. Formation of switchboard will be single Tier for ACB and Two/ Three tiers for Switchgears. Main Busbar chamber will be on top of these tiers and vertical Busbar chambers connected to main bus will feed to various feeders.

B) BUSBARS

1. The switchboard shall comprise high conductivity electrolytic copper 3 phase and neutral busbars, which shall be extended through all units of the switcher line - up. All phase busbars shall be of uniform cross sections throughout the length of the switchgears and shall be sized to carry continuously the current specified.

2. The busbar shall be dynamically braced and thermally sized for short circuits PVC sleeves shall be provided for the busbars.

3. Neutral bus shall be rated for half the capacity of phase bus. All connection bolts and nuts shall be accessible in such a way that they can be checked with normal tools. Minimum clearance between live parts between phase and neutral and also between phase and neutral with ground must as per IS 4237.

4. The busbar supports shall be made of high quality non-hygroscope non- flammable high tracking index class KA3c withstanding temp up to 130° C high impact tensile strength fiber glass reinforced polyester insulators.

5. Current density of copper Busbar shall not be more than 1000 A per square inch.

6. Final temperature of busbars at rated current shall be limited to 85° C.

C) PAINTING

1. All metal surfaces shall undergo seven-tank process and shall be thoroughly cleaned and degreased and derusting with alkali and acid to remove mill scale grease rust and dirt. Fabricated structures shall be pickled and then rinsed with water to remove any trace of alkali /acid. Then phospating coat shall be applied.

Also two coats of Zinc chromate stove primer shall be applied. The surface shall be made free from all imperfections before applying the second's coat of primer. The switchboard shall be spray painted with two coats of synthetic enameled paint of light gray of shade 631 of IS-5 and egg shall white from inside.

2. All unpainted steel parts shall be cadmium plates to prevent rust corrosion. If these parts are moving elements, then they shall be greased. Suitable lifting lungs shall be provided which shall not leave any opening when removed.

D) SPACE HEATERS

Each vertical cubicle shall be provided with 40W space heaters to prevent moisture condensation and maintain cubicle temperature 5C above the ambient.
The space heaters shall be located at the bottom of the switchboards and shall be controlled through a common thermostat with an adjustable setting and a manually operating switch. The thermostat shall preferably be located in the metering/relay chamber. For space heater one common 25A DP switch and two EE HRC fuses shall be provided.

SWITCHBOARD COMPONENTS

A) SWITCHES

Switches shall be air break type as per IS: 4047 and of Ac-23 duty The switch operating handle shall be front mounted and interlocked with the door such that door cannot be opened when the switch is ON. The live parts shall be shrouded with suitable insulating barriers so as to prevent accidental contact with the live parts after opening the cubicle front door. Motor control switches are suitable for reliable and safe starting and stopping of 3 phase AC motors even under heavy starting locked rotor condition.

B) FUSES

All power and control fuses shall be of link type. Screw type Dz. fuses will not be acceptable. All fuse links shall be HRC type and shall generally conform to IS 2208 Rewirable fuses will not be acceptable. All fuses shall be readily accessible for replacement. It shall not be necessary to remove any piece of equipment or to disconnect wiring before replacing fuses 20% of spare HRC fuses to be supplied along with the switchboards.

C) CONTROL SWITCHES

1. All control switches shall be rotary back-connected types having a cam operated contact mechanism Preferably phosphor bronze contacts. Unless otherwise specified circuit breaker control switches shall be 3- positions spring return to neutral from both ON and OFF positions. They shall have pistol grip handles.

2. Ammeter selector switches shall have make before break feature on its contacts. The selector switches shall generally have four positions for reading three phase currents and neutral. The voltmeter selector switch shall also have four positions Three shall be used to measure phase to phase voltages and the fourth shall be OFF position.

D) INSTRUMENT TRANSFORMER

1. Current and voltage transformer shall preferably by cast resin insulated. Primary and secondary terminals shall be clearly labeled.
2. Current transformers shall generally conform to IS 2705.Generally they must be mounted on the stationary parts, not on the bulbar for general guidance the vendor shall note that the protective current transformers shall have an accuracy class 5p and an accuracy limit factor 10.0 low reactance CTS shall be used for protection. Current transformers for instrument shall have an accuracy class I. O. and accuracy limit factor less than 5.0. The current transformers shall be capable of withstanding the peak momentary short circuit and symmetrical short circuit current for 1.0 second. The neutral side of the current transformer shall normally be earthen through a link.

E) MEASURING INSTRUMENTS

All measuring instruments shall be square pattern moving iron 90° scale 96 * 96 mm² flush mounted type. Instrument shall be of accuracy class I.O. as per IS: 1248 Ammeters for motors feeders shall be graduated for full load current of the motor with a compressed scale at the end for at least (six) times the full load current. The kW meter and P.F. meter shall be suitable to measure unbalanced loads on 3 phase 4 wire system P.F. meter shall be of 0.5 - 1- 0.5 range.

F) INDICATING LAMPS

Panel mounting type low power consumption indicating filament lamp suitable for specified voltages shall be used. Lamps shall be provided with suitable current limiting resistors & fuses lamp shall be provided with translucent lamp coves to diffuse light. Lamps shall be provided with bayonet cap bulbs.

G) PUSH BUTTONS

Push buttons shall be suitable for panel - mounting type comprise of a contact element and an actuator. The contacts are of silver alloy of a 10 A continuos current rating. Each push button shall be provided with 1 NO + 1 NC contacts. But if required 2 NO + 2 NC contacts shall be provided at no extra cost. Colour of the knob shall be as per I.S./B.S.

H) PROTECTIVE RELAYS

1. Wherever used all protective relays shall be back-connected flush mounted draw out type and with flag indication. The relay cases shall have provision for insertion of test plug at the front for testing and calibration using and external power supply without disconnecting the permanent wiring. It shall be possible to short the CTS through the test plugs.

All relays shall preferably be mounted in front of the panel and shall be as specified on the single line diagram. The current and voltage coils shall be rated as specified on the single line diagram. The current and voltage coils shall be rated as specified on the drawings. All relays shall generally conform to I.S. 3842 I.S. 3231 and hand reset type.

I) NAME PLATES

1.A nameplate with the switchgears designation shall be fixed at the top of the switchboard. A separate nameplate giving feeder details shall be provided for each panel.

2. Nameplate shall be provided for each piece of equipment such as lamp pushbutton switch relays etc mounted on the switchboard Special warning plates shall be provided on all removable covers or doors giving access to cables or Busbar. Identification tags shall be provided inside the panels for switches, fuse, contractors, O/L relays etc matching with those shown on the circuit diagram.

1. Rubber grommets shall be provided so that metal parts should not come in contact with any power or control wires/cables.

2. Minimum size of terminal for control wiring shall be 10 mm2. Clipon type terminal shall be provided. 20% spare terminals shall be provided on each terminal block.

3. Stranded conductor shall be provided with copper lungs at both ends before connections are made.

J) EARTHING CONNECTIONS

All cubicles shall be incorporated with a copper earth Busbar running throughout the length of the switchboard. The earth bus size shall be 25 mm x 6 mm horizontal. All doors and moveable parts shall be connected to the earth bus with flexible copper connections. Provision shall be made to connect the earthing Busbar to the plant earthing grid at two ends. All non current carrying metallic parts of the mounted equipment shall be earthen.

J) DANGER NOTICE PLATE

Danger Notice plate with symbol as per I.S. shall be provided on switchboard.

FUSE PULLER

One fuse puller to be supplied along with each switchboard.

K) TESTS AND INSPECTION

1. During fabrication switchgears shall be subject to inspection by the consultant. Manufacturer shall furnish all necessary information concerning the supply to inspectors.

2. Tests shall be carried out at manufacturer plants under his care and expense. All routine tests as specified by the applicable standard code shall be conducted. Type test certificates of a recognized testing organization shall be furnished with the bids.

3. In addition specific tests shall be conducted to check mechanical and electrical operation and switchboard wiring to the specification and schematic diagrams. These tests shall be provisionally conducted at manufacturer plant by providing temporary connection to switcher units in order to simulate the actual conditions. Tests shall be finally performed at site in presence of manufacturers specialist once the external cables connection have been completed.

4. Shop tests shall be witnessed by an agency authorized by the consultant.

5. Acceptance tests shall be as follows:

(a) A general visual check shall be carried out. This shall cover measurement of overall dimensions locations number and type of devices terminal boxes and connections of terminals etc.
(b) Manual and electrical operation or CB/relays/contractors etc shall be checked under the worst conditions of supply voltage. Also continuity test shall be taken.
(c) Insulation resistance of the main and auxiliary circuits shall be checked before and after high voltage test.
(d) High voltage test.
(e) Operation check shall be carried out for every control function as per the schematic diagrams by manually simulating fault conditions and operation of control switches/relays etc.
(f) Relays shall be tested with secondary injection test equipment.
(g) For equipment purchased from other sub suppliers certificate test reports of test carried out at the manufacturer's works shall be submitted.

N) DRAWINGS

1. The consultant's schematic diagrams are intended as a guide and contractor shall develop his own general arrangement and schematic drawing adding necessary auxiliary devices, accessories, components peculiar to supplied equipment ferrules number terminal number etc which are required for safe convenient efficient & proper operation of the 415V power center.

2. Manufacturer shall submit single line general arrangement drawings including material list, foundation drawings and control wiring drawings to the consultant. Approval of general arrangement shown in the drawings is required before the fabrication of cubicles is started. Approval of schematic drawings single line and control wiring drawings shall be obtained before the manufacturer proceeds with the cubicle wiring. The approval of manufacturer's drawings shall not relieve the manufacturer of his responsibility of supplying equipment conforming to the relevant specifications and standards or for any mistakes errors or omissions in the manufacturers drawings.

3. Once manufacturers schematic diagrams have been finally approved the manufacturer shall prepare wiring connection diagrams for each cubicle. This diagram shall show all wiring inside the cubicle starting from the cubicle terminal strips. These diagrams small be used for trouble shooting and shall show every device terminal and wire number.

4. Manufacturer shall submit the ten- (10) copies of final prints and one (1) reproducible tracing of each and every drawing.

O) PACKING AND TRANSPORT

The switchboard shall be shipped to site packed in wooden crates. They shall be wrappers with polythene sheets before being placed in crates to prevent damages to the finish crates shall have skid bottoms for handling.

AUTOMATIC POWER FACTOR CORRECTION PANELS

1.0 GENERAL:

The specification covers the Design, Manufacture, Testing at works, supply of 415 V Automatic Power Factor Correction Capacitor control panel.

2.0 STANDARDS:

The equipment shall conform to the following Indian Standards. IS : 9244 - HRC Cartridge fuse links

or MCB
IS : 2147 - Degree of protection provided by enclosures for low voltage switchgear. IS : 2516 - AC Circuit Breakers (MCCB)

IS : 8828	-	MCCB's
IS : 2705	-	Current Transformers (Part I
to IV) IS :1248		- Direct acting electrical
IS : 2834	-	Capacitors.

3.0 CONSTRUCTION:

The Panels shall be floor mounting, fixed type, single front, self standing, totally enclosed to make it dust and vermin proof.

The Panels shall be fabricated with 14 SWG cold-rolled sheet metal. The Panels shall be fully compartmentalised with all doors in front only. The number of steps and the KVAR rating of the Panels shall be as per BOQ. Adequate lifting facilities shall be provided and the lifting eye bolts are removable. The panel consists of 3 nos. of bus-bars for Phases and 1 no. for neutral. The bus-bars are of high conductivity aluminium and are of sufficient cross section to carry fault current without any damage. The bus-bars shall be supported on epoxy cast resin insulators and covered by heat shrinkable PVC tapes. The main bus bars shall be adequately supported to withstand stresses developed due to short circuit current. Tapping points shall be treated against oxidation. Appropriate identification markings/labels shall be provided on the bus-bars and trappings for distinguishing the various phase and neutral.

The cable alleys shall be provided with hinged doors for each access to cables inside. The cable alley door shall be provided with bolts, which can be opened with special keys by authorized persons.
The compartment doors shall open away from the cable alley and shall be provided with special locks, which will ensure tight closing of doors making the compartment effectively dust proof.

The fabricated panel shall undergo a treatment of degreasing, picking and 2 coats of primer, before inside and outside powder coating.

The equipment inside the compartment shall be arranged in a logical manner for ease of reference at site. Undrilled gland plates shall be provided at top and bottom of the panel and shall be removable type with nuts and bolts for proper fixing. The control supply shall be tapped after the mains incomer MCCB. Control circuit shall have protection fuses / MCB's. Indicating lamps shall be provided on each rack. Capacitors "ON" & "OFF" indications shall be provided on APFC relay. Panels shall be provided with cooling fan, if required for containing the excessive temperature with suitable mesh doors for natural ventilation as required by the Electrical Inspectorate. Capacitor should be mounted in side the panel and proper ventilation to be provided.

4.0 HRC FUSES:

HRC fuses shall be link of reputed make and shall have rupturing capacity of 80 KA.

5.0 CONTACTORS:

Contactor shall be of electromagnetic type rated for uninterrupted duty as defined in IS-2959 unless otherwise specified and also suitable for capacitor duty. The Main Contactor shall be of silver or silver alloy. The insulation class for the coil shall be class E. Each contactor shall be provided with 2 N/O and N/C auxiliary contacts. Contactor coil rating shall be minimum of pick up 85% of rated voltage and minimum drop out of 75% rated voltage.

6.0 PUSH BUTTONS

Push buttons shall be generally shrouded. Each push button shall be provided with 1 N/O and 1 N/C auxiliary contacts. "Stop" push button shall have, 'stay-put' feature. Colour code shall be as per IS-6875.

7.0 INDICATING LAMPS

2 Nos. indicating lamps shall be provided in each capacitor feeder with red and green colour to indicate 'ON' or 'OFF'.

8.0 CURRENT TRANSFORMER:

Current transformer shall be double wound, dry type and shall have good regulation (5% or less) to cope with inrush current of contactor coils with sufficient rating of HRC fuses for primary and secondary.

9.0 SPACE HEATERS:

Anti-condensation space heaters, with thermostat suitable for 230 V, 1 Ph supply along with a switch fuse shall be provided in each panel.

10.0 CONTROL SWITCHES:

A general-purpose control switch shall be provided for selection of "Auto" & "Manual". The switch shall be provided with engraving plate in the front with "Auto", "Manual" & "Off" inscription. This switch shall be normally of the fixed control bar type heavy duty unit.

11.0 APFC RELAY: The Panels shall be provided with APFC relay having 4/6/ 8/10/12 steps with facility for setting target P.F. range in the form of high and low, step indication, low current

indication, auto manual selection. A 7-segment LED display is provided to indicate existing power factor. The relay also provides over voltage protection up to 10% of rated voltage. Lead power factors are completely eliminated and the switching takes place on FIFO arrangement.

12.0 CAPACITORS:

The capacitor banks shall be designed as per IS: 2834 & IEC 831-1-2.

Capacitor design shall be intended for high power industrial application with extreme demand for service life, constant capacitance and high inrush current withstand capability. The capacitor shall be compact, self healing, MPP, gas filled capacitor. The current carrying metal layer (electrode) to be vapour deposited on to one side of film. The capacitor shall be composed of three single face element stacks, connected in delta. The winding elements to be housed in a cylindrical aluminium case and hermetically sealed by a press rolled metal lid.

The capacitor shall be of dry technology. Instead of liquid impregnated agent the capacitor is filled with nitrogen house. So there is no risk of fire caused by leakage oil. The capacitor shall be self healing type and shall have an over pressure disconnector. This over pressure disconnector prevents the capacitor from bursting at the end of its service life or caused through electrical or thermal over load. The SIGUT termination shall ensure no loose screws and shall protect against electric shock hazards.

Capacitor banks shall comprise of identical delta connected three phase units. Capacitor banks shall be dry type metalised polypropylene type & shall be self healing and filled with non toxic & non flammable material.

Capacitor shall be compact in size and hermetically sealed. Internal silver fuses shall be provided for protection of each capacitor element. The capacitor bank to be complete with fixing channel suitable for floor mounting.

Incomer circuit breakers: MCCB as specified in the Schedule of Quantities

13.0 EARTHING:

The Panels shall be provided with 2 earthing terminals of minimum M8 size on both sides of the Panel.

14.0 TESTS & INSPECTION:

The Panel shall be completely assembled, wired and tested as per IS-8623 at the factory in the presence of the Consultant/Purchaser's Engineer at no extra cost.
The test shall include wiring continuity tests, insulation resistance tests, high voltage tests (2.5 KV AC for 1 min) and functional tests to ensure operation of control scheme and individual equipment.
Manufacturer's Test Certificates in respect of all meters, contactors, switch fuse, capacitors, MCCB, ACB etc shall be forwarded to Owner prior to inspection, by Bidder

15.0 BUSBARS AND INSULATING MATERIALS

The control panel shall have single bush bar pattern with air insulated Busbars housed in a separate compartment, segregated from all other compartments, with the sheet steel barriers. Busbars shall be of high conductivity electrolytic copper suitable for carrying the rated and short time current without over heating. Busbars shall be adequately supported on insulated to withstand dynamic stresses due to short circuits.

Busbars shall be designed for the specified fault level, time and continuos current rating and shall have the same rating throughout the length of the control panel and shall be insulated and sleeved throughout. The neutral busbar when specified shall be of not less than half the current carrying capacity of the phase busbars.

Arc propagation barriers shall be provided to prevent arcs from flashing to the main busbars. Similarly the control panel shall be designed to prevent arcs flashing across bus-tie units.

All busbar connections and bus taps to individual feeders shall be either by means of 1100 / 650 V grade PVC insulated wires or links insulated with shrunk PVC sleeves. Busbars shall be colour coded for ready identification of three phases.

All insulating materials used in manufacture shall be non-hygroscopic, aging proof, non-fire propagating and shall be treated for preventing fungus growth. Surface of insulators shall be highly glazed and treated with silicone compound to minimise accumulation of dust, condensation of moisture and tracking. The insulating materials shall preferably be non carbonising type. The insulating material shall have resistant to superficial discharge.

The temperature rise, above the design ambient temperature, permitted under normal working conditions with rated current flowing is as follows :

Insulated & non insulated busbars	**- 50 C**
Conductors with PVC sheath	**- 30 C**
Conductors with both side insulated	**- 65 C**
Other Contacts	**- 50 C**
Metallic parts without voltage	**- 40 C**
Exterior surfaces	**- 15 C**

16.0 ISOLATORS

Isolators shall be two position (ON / OFF) type, heavy duty, load break quick make and break type complying with the requirements of BS EN 60947-3 and suitable for front of board operation & capacitor switching.

Isolators to be interlocked with compartment door to prevent opening or closing of the door in the closed (ON) position of the isolator, in case of compartmentalised switchboard. Provision for padlocking the isolators in open or closed position also to be made.

All live terminals on the isolators to be adequately shrouded to prevent accidental contact and danger to the personnel.

The isolators shall be provided with 2# NO+NC contact for

'Status Indication'. SWITCH DISCONNETOR FUSE AND MOULDED CASE CIRCUIT BREAKERS.

All fuses shall be non-deteriorating high rupturing capacity, link type mounted in suitable fuse carriers or fuse bases, conforming to BS 88.

Fuses shall be provided with operation indicators and it shall be possible to change fuses with the circuit

live. All fuses in control, indication and metering circuit shall be HRC, link type.

Insulating fuse pulling handles shall be supplied for each size of fuse with the control panel. The switch

disconnector fuse units shall be provided.

MCCB's shall be short time fault rated to comply with 'service' category of performance to BS EN 60947-2 and shall be of "Utilisation: Category 'B' to give adequate fault discrimination. The MCCB shall be suitable for capacitive current switching.

The MCCB units shall be provided with 1# NO+NC contact for 'Status Indication' & 1# NO+NC contact for 'TRIP' indication.

17.0 CONTACTORS

Contactors shall comply with IEC 158-1 and 1A and shall be air break, electromagnetically operated and electrically held unless otherwise specified in the data sheets.

All power contactors shall be rated for capacitor current switching. Minimum rating shall be not less than 9 Amps. The contactors shall be provided with inrush limiting resistors, especially designed for capacitor switching.

Coils shall be continuously rated and capable of withstanding 106% voltage continuously and 110% voltage infrequently. Coils shall have a minimum pick up voltage of 85% rated volts and a maximum drop off voltage of 60% rated volts. The trip coil of latched contactors shall operate correctly at 75% of rated voltage, unless specified otherwise on the datasheets.

Contactor breaking capacity shall be compatible with the protection afforded by the overload relay in conjunction with the fuses. Faults in excess of the contactor rating shall be cleared by the fuses.

All power contactors shall be provided with minimum 1 nos. Normally open (NO) and 1 nos. Normally Closed (NC) auxiliary contacts; preferably, convertible from NO to NC and vice versa.

All contactor coils to be suitable for climatic conditions specified in Data Sheets. Insulation Class for Coils – Class 'E' or higher.

18.0 INDICATING LAMPS & PUSHBUTTONS

18.1 INDICATING LAMPS

Indicating lamps shall be LED type with Low Voltage Glow Protection Cluster type LED (min-8) 300 lux. Lamp covers shall be provided with interchangeable coloured lenses of Perspex or equivalent unbreakable material. It should be noted that lenses should not get discoloured in course of time, due to the heat generated by the lamps. Requirement of indicating lamps will be indicated in Data Sheets / wiring diagrams. Lamp holder provided shall be suitable for easy removal / insertion of lamps.

The colour of indicating lamps shall be as follows:

Red	-	Feeder 'ON'
Green	-	Feeder 'OFF'
Amber	-	Auto Trip
RYB	-	Potential indication for 3Ph AC supply.

18.2 PUSH BUTTONS

Push buttons to be provided on front door.

Stop Push Button – with stay put feature, (preferably lockable) with mushroom head. Reset Push Button

– for hand resetting of BMR (to be provided only if called for).

Start Push Button – Shrouded type spring return (to be provided only if called for). Colours of the push buttons:

Stop	-	red (stay put type)
Start	-	green
Reset	-	black or yellow

18.0 CURRENT TRANSFORMERS – CAST RESIN

Current transformers shall be bracket mounted & conform to BS 7626. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses due to maximum short circuit current, available at the point of installation of current transformer.

Secondary terminals of the CT shall be brought out suitable to a terminal block that will be easily accessible for testing and external connections.

Terminals shall be marked in accordance with BS 7626. A rating plate as per BS 7626 shall be provided on each current transformers.

Current transformers associated with circuit breakers shall be mounted in the stationary portion of the control panel to permit complete interchangeability of similar breakers.

Current transformers shall have short time current ratings not less than that of the switchgear or, in the case of fuse protected units shall be capable of withstanding the let through current of the maximum size of fuse link that can be fitted.
Where current transformers are connected in star, the star point shall be earthed through a removable link.

Shorting links shall be provided at the outgoing terminals, where protective circuit wiring leaves the control panel.

The Supplier shall be responsible for ensuring that the current ratio and volt-ampere rating of the current transformers are suitable for the functions, loads and duties they are required to supply.

The accuracy class shall be as specified in the datasheet.

The supplier shall supply magnetisation curves for each protective current transformer.

Current transformers used to power remote equipment shall be rated at not less than 10 VA and shall have 1 amp secondary.

19.0 INTERNAL WIRING

Control panel shall be complete with all internal wiring and ready for Purchaser's external cable connections at the outgoing terminals. All inter-modular wiring within the control panel for control and interlock looping shall be carried out by the control panel supplier.

All wiring inside the control panel shall be carried out with 1000/600 V grade PVC insulated wires having fire & moisture resistant properties.

All control wiring except CT secondary wiring shall be carried out with minimum 1.5 sq. mm copper conductor. CT secondary wiring shall be carried out with 2.5 sq. mm. Copper conductor.

All terminal blocks and wires shall be tagged for identification in accordance with BS EN 60439.

All wiring for external connections shall be brought out to the individual terminals on a readily accessible terminal block. All terminal blocks shall be shrouded or provided with transparent covers.

Clamp type control terminal blocks shall be provided for outgoing control cables. Minimum 10% or 4 nos. spare terminals shall be provided for future use. Control terminal block shall be separated from power terminal blocks by means of an insulating barrier.

Flexible cables shall be used for wiring to equipment on doors and shall be so arranged that it does not get trapped during door movement.

19.0 SPACE HEATERS

Adequately rated anti-condensation space heaters shall be provided in each breaker panel and in cable alleys of the control panel to maintain control panel inside temperature 10 C above outside ambient temperature.

Space heater shall be strip type, rated for operation of 240 V, single phase, and 50 Hz. AC supply unless otherwise specified.

Each heater shall be complete with a rotary type ON/OFF switch, HRC fuse in the phase, neutral link in neutral and a control thermostat.

Isolator and link type HRC fuses for control of space heater for motor controlled by the motor starter / circuit breakers wired through auxiliary contact of the contractor / circuit breaker shall be provided wherever specified.

20.0 CABLE TERMINATIONS

Cable entry to control panel shall be bottom of the control panel as specified in the Data Sheets.

Ample space shall be provided in the cable compartment to accommodate XLPE insulated copper conductor cables as specified in the Data Sheets / Single Line Diagrams.
Removable undrilled gland plate shall be provided for termination of cables. Attention shall be given to the space and bending radii required for copper and larger copper cables.

Gland plates shall be located at the bottom of switchgear (where bottom cable entry specified) and shall be of sheet steel material unless they accommodate single core cables in which case the material shall be non- ferrous.

Cable supports shall be provided, to hold in position, cables running for a greater part of the way up or down the height of the control panel, or where the weight of the cable will create an undue strain on the cable gland plate.

The supplier shall specifically state if the cable termination cannot be accommodated within the normal height of the control panel.
Power terminals shall be provided with an approved means of locking the connections and space shall be allowed for crimping lug termination.

21.0 PAINTING AND FINISHING

All metal works and metal parts of the control panels shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphatising, passivating and then sprayed with a high corrosion resistant primer.

The primer shall be baked in an oven. The external finishing treatment shall be by application of two coats of epoxy based powder coated paint (anti-acid) of shade RAL 7032. The inside of the board shall be painted with anticondensate paint of same shade.

Both inside & outside paint shall be fireproof or with a low heating power value.

22.0 NAMEPLATES AND LABELS

One nameplate giving designation of the control panel shall be affixed prominently on top of the control panel. Details of designation shall be as follows: I Year of Manufacture

II Supplier's name

III Purchaser's name and order number

IV Control panel designation

V System voltage, phases, wire

VI System frequency

VII System fault level

VIII Busbar rating

IX Site International Standard

Labels giving following details shall be affixed on each feeder panel :-

I Feeder No

II Equipment Reference Number and Description

III Rating (kVAR)

All components whether mounted inside the control panel or on the door shall be permanently and clearly labelled with reference number and / or letter of their function. (Rating of fuse shall form a part of the fuse designation).

Labels are to be secured with mechanical fasteners, not adhesives and shall comprise engraved plastic with black letters on a white background except for 'Danger' labels which shall have black letters on a yellow

background. 'Danger' labels shall comply with BS 5378 Part 1 or IEC 417.

Labels for feeder panel designation shall be fixed on the front & rear side of respective panels. For with drawable units, identification labels shall be duplicated on both the with drawable and the fixed parts. These labels shall be identical size to permit interchange.

23.0 DRAWINGS AND INFORMATION

The Supplier shall furnish drawings in accordance with "Supplier's Data Requirements", enclosed with the Data Sheet.

Generally following drawings shall be furnished:-

1. General Arrangement Drawing showing front view, plan, foundation plan, floor cutouts and trenches for external cables, elevations, transport sections with weights;
2. Schematic and control wiring diagrams for each type of feeder and protection, including indicating devices, metering instruments, alarms, space heaters etc.
3. Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.,

24.0 TESTS AND TEST CERTIFICATES

Supplier to carryout all routine tests and 'Loss Angle' test on each bank and to furnish test certificates as given in 'supplier's Data Requirements' & 'Vendor Quality Plan' attached.

25.0 INSPECTION

Owner reserves the right to inspect the Capacitor Banks and witness the tests as Supplier's works, before dispatch.

26.0 TOOLS

Where special tools or other equipment are required for maintenance, adjustment or other servicing the supplier shall include for all such equipment in his scope of supply. He shall also include for a circuit breaker handling trunk if applicable, and a truck for removal of with drawable starters if over 25 kg.

27.0 SPARES

The supplier shall provide with his quotation separate priced list of recommended commissioning and operating spares. Commissioning spares (list of which shall be approved) shall be purchased with the main LV control panel.

28.0 QUALITY ASSURANCE

Quality Assurance shall follow the requirements as specified in the enquiry / purchase order.
Q.A. involvement will commence at enquiry and follow through to completion and acceptance, thus ensuring total conformity to Purchaser's requirements.

29.0 DEVIATIONS

Deviations from the Specifications must be stated in writing at the quotation stage. In absence of such a statement, it will be assumed that the requirements of the Specifications are met without exception.

CABLES

1. GENERAL

MV Cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawing specification and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

2. MATERIAL

The MV Cables shall be XLPE insulated aluminum / copper conductor armored cable conforming to IS 1554 of 1972 (part -1) laid in trenches ducts and underground as shown on drawings.

Specification of cables will be as follows:

Cables with Aluminium and Copper conductor and polymer insulation will be manufactured at Cable Works. Essentially cables comprise of conductors, insulation, innersheath, armour and outersheath.

CONDUCTOR

Cables will be available with both aluminum and copper conductors manufactured with solid/Stranded Circular/Shaped Aluminium / Copper Conductor.

Compaction is provided to all stranded conductor constructions as under:

1. Circular Conductor :

With one wire in the centre conductor will contains 6, 12, 18, 24, 30. wire layers in either unilay or opposite helical directions. The conductor will be sized upto 92% compaction.

2. Shaped Conductors :

In all multicore cables from 16 Sq. mm size, conductors will be "shaped". Compaction degree in multicore power cables is upto 92%.

3. Segmental Conductor :

Cables of 16 sq. mm will be made up of segmental conductors. The conductor is to be manufactured in equal segments and compacted,

then laid together. This will reduce A.C. losses in the large sized conductor, which are due to skin and proximity effects.

Copper conductor cables are to be of the same construction that of cables with Aluminium conductor except for high tensile strength, superior conductivity, better flexibility and ease of jointing, Copper cables are used in control, instrumentation, winding, submarine, mining and ship wiring etc. etc applications.

All Conductors are to be manufactured strictly in accordance with National and International specifications. National specifications IS:8130 International specification IEC:60228 / BS:6360

DIELECTRIC INSULATION

Insulation for cables is to be strictly as per

National and International specifications Cables are to be designed and manufactured with polymer dielectrics to bear thermal and

thermomechanical stresses safely at continuous normal and short circuit temperature conditions. Cables are to be with both thermoplastic & thermo setting insulations.

- PVC Cables Thermoplastic dielectric
- XLPE Cables Thermo setting dielectric

PVC cables to use PVC compounds that take care of over load and short circuit current with both coarse & fine protection systems.

XLPE cables to use XLPE compound with anti oxidant stabilizers and traces of aromatic polynuclear hydrocarbon. Thus improving electrical treeing characteristics and mechanical strength of insulation. Cables are to be friendly during continuous, emergency and short circuit conditions.
The latest manufacturing process is to be used , to gives improved reliability and compactness to cables. The relative thermal expansion during short circuit between dielectric and conductor is therefore limited to minimum both in PVC & XLPE, thus limiting displacement of cores in cables during short circuit.
Insulation for Cables are to be strictly manufactured and applied over conductor in accordance with National and International specifications:
National Specification IS:5831/IS:7098
International Specifications BS:6746/BS:5467/IEC:60502

SCREENING
XLPE Cables with rated voltage over 3300V shall be provided with conductor and insulation screening as follows:
Conductor Conductor shall be screened with extruded Screen semiconducting compound as per is:7098 part 2. Insulation Insulation screening shall consist of non-metalic Screen part in combination with metalic part. Non metalic part shall consist of either semi conducting compound tape applied hellically or extruded
layer of semi conducting compound, applied directly over insulation. Over this, metalic part (copper tape) shall be applied hellically with overlap as per IS:7098 part 2.
To avoid the cavities and voids formation in dielectric particularly on bending operation of cable, perfect bonding of insulation and screening is required. To ensure this,apply conductor
screen, insulation and insulation screen (non-metalic part) in one operation through tripple extrusion.

LAYING UP
Cores are to be tested on line during production both for physcial and electrical characteristics. Control is to be observed within tight tolerance limits for dimensions in case pf PVC/XLPE insulation. For multicore cables cores are to be laid up on our latest laying up machine equipped with sector correction equipment. In case of XLPE insulated cores the same are to be cured so as to impart the requisite characteristics both electrical and mechanical and then are to be laid up.

INNERSHEATH
Laid up cables are to be provided with inner sheath with high quality of PVC which will act as bedding for steel wire / strip armouring.
Wherever required, f iller cords are to be provided to maintain the circularity to laid up cables.
Cable-polymers used for inner sheath are to be softer than insulation or outer sheath & are to be compatible with temperature ratings of cables & do not have deleteriocus effect on any other component of cable.
Inner sheath is to be applied either with extrusion or by wrapping. Though the inner sheath is to be closely applied on the laid up cores, same could be stripped with ease without damaging insulation.
The inner sheath dimensions are to be maintained strictly in accordance with laid down specification. Specification For PVC Cables IS:1554 (Part-I & II) For XLPE Cables IS:7098 (Part-I & II)

MANUFACTURING PROCESS
MANUFACTURING OF CABLES ARMOURING

Mechanical protection to the cable is to be provided with armouring.
Single core cables are to be armoured with Aluminium or Aluminium alloy wire/strips, thus avoiding magnetic hysteresis losses on A.C. system.
Multicore cables are to be provided with galvanised steel wire/strips. Cables are to be provided with galvanised wire armouring, where cables are to run vertically and are subjected to stresses.
Mining cables are to be armoured with steel wire and tinned copper wires, so as to provide conductivity of armour more than 75% of main conductor of cable.
Cables armour wires/strips are to be of low resistivity material and meet the requirements of IS:3975.
Armoured cables are to be with almost 95% armour coverage.

OUTERSHEATH
All Cables are to be provided with PVC/polymer outer sheath. Cables are to be manufactured with various characteristics of sheathing compounds.
General purpose sheathing Compound ST1 Heat resistant Compound ST2 for sheath (H.R.)
Fire Retardant Low IEC 754 Part I Smoke Compound IEC 60332
Part I& III (FRLS) IEEE-383
ASTM-2843
ASTM-2863
Flame Retartant Compound (FR) to EIL Specn.
Ultra Voilet Radiations Resistance Compound to ASTM G-53. Anti Rodent and Anti Termite Compound.
PVC compounds used for Cables are to be of various grades to meet specifications IS: 5831.
In order to be identified, Cables to have their name embossed/printed/indented on outer sheath at regular intervals. On the outer sheath of Cables, Voltage Grade, cable size,
trade name & year of manufacture are to be embossed, as desired. Cables are to be sequentially marked for length at every metre throughout its length.

FINAL TESTING
Each Cable is to be tested for all applicable Routine Tests. From a lot of Cable one cable of each type is to be tested for Type tests, as per relevant specifications.
Testing of Cables are to be carried out as per applicable Standards for testing.

3. INSPECTION
All cable shall be inspected upon receipt at site and checked for any damage during transit.

4. JOINTS IN CABLES
The contractor shall take care to see that all the cables received at site are apportioned to various location in such a manner as to ensure maximum utilization and joints in the cable will not be acceptable.

5. LAYING CABLES
Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable.

The cable drums shall be laid placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks the drums shall be unrolled and cables run over wooden rollers in trenches. Underground Cables shall be first be laid in excavated trench on 80mm layer of sand. The second layer of 80mm sand shall then be sprayed over the cable. Bricks on the top layer of sand protect the cables. Distinguishing marks shall be made on the cable. Rate shall be inclusive of excavation in available strata of soil, Supply and laying of sand bricks, Supply and laying of cables, Backfilling of earth, Removal of excess earth etc. While erecting the cable on wall, m.s. Spacers are to be erected on wall by means of philplug/ wood screw/cement screw, then cable is dressed properly and GI saddles to be fixed on spacers by machine screw. GI saddles shall be having minimum 20 G. The fixing of cable shall be minimum 400 apart for horizontal runs and 800 mm apart for vertical runs. Any civil work like breaking, digging and making good is deemed to be included the rate.

6. Cable Terminations of MV Cables and joints

a) Cables terminations shall be done with suitable brass cable gland and tinned copper cables lugs only.

b) The cable lugs shall generally fixed to the cable cores by crimping processes.

c) Irrespective of the cable and method of termination the core and shall be cleaned and immediately be covered with an oxide inhibiting / corrosion inhibiting compound before terminating.

d) The tail end wires shall be finished in an appropriate colour by using PVC insulating tapes.

LIGHTING FIXTURES

1. SCOPE.

Manufacturer at works will test the light fitting specified in the tender. The same fittings will be purchased, transported, delivered to site. Necessary manufacturer's test certificate will be submitted to Consultants.

2. STANDARDS

Lighting fittings covered against these specifications shall comply with the relevant latest Indian Standards and codes.

3. CONSTRUCTION

(a) The fitting shall be suitable for 240 volts single phase AC supply +/- 5% and frequency 50 Hs. +/- 3%.

(b) Industrial and decorative fittings shall comprise of mounting rails and other accessories. The decorative fitting shall be provided with louvers as specified. The decorative fittings should be suitable for recessed mounting in the false ceiling fully wired up to terminal block. Fittings will be with electromagnetic or high frequency electronic ballast as specified.

(c) Where conductors are required to be drawn through tube or channel leading to the fitting, the tube or channel must be free from sharp angles or projecting edge, and of such size as will enable them to be wired with the conductors used for the final circuit without removing the braiding or sheathing. As far as possible all such tubes or channels should be of sufficient size to permit looping back.

(d) Wires used within prewired fittings shall be flexible with PVC insulation and 14/0.193 mm (minimum) copper conductors. The leads shall be terminated on built-in terminal block, ceiling rose or connector.

(e) All Fittings will have power factor correct capacitors mounted integrally. An earth terminal with suitable marking shall be provided for each fitting.
Fittings shall be installed such that the lamp is at a height of 2.5m above floor level, unless directed otherwise.

LIGHTING FITTING COMPONENTS/ACCESORIES

(a) BALLASTS/CHOKES

These shall be compact in design copper wound, low power loss, good heat dissipation. With no humming sand and filled with polyester and energy saving ballast shall be used

(b) STARTERS

The starters shall have hermetically sealed glow switch and radio suppression capacitors suitably designed to withstand striking voltage of tube and to ensure long lamp life starter holder shall moulded type either made up of phenol-formaldehyde.

(c) CAPACITORS

These shall be low loss types to improve power factor up to 0.91 to 0.95 lag. Capacitor housing made up of corrosion resistant material and shall be hermetically sealed type.

(d) LAMP HOLDERS

These shall rotary spring-loaded resilient type either brass or moulded from unre- Fromaldehyde.

The holder shall be rigid enough to maintain shape on application of a nominal external pressure. There should be sufficient threading for fixing the base to the lamp holder part so that they do not open out during attention to the lamp or shade.

Lamp holders for use on brackets and the like shall have not less than 1.3 cm nipple, and all those for use with flexible pendant shall be provided with cord grips.

(e) LAMP FLUORESCENT

These shall be cool day light as per the stated wattage of 36W.
Colour of Tube will be 86 in office area And 82 in Reception and Canteen area.

LIGHTING AND POWER PANEL

Power and lighting panel shall be made out of 14-gauge sheet steel, vermin and dust proof, compartmentalized vermin and dust proof construction to provide generalpurpose indoor/outdoor type of enclosures as per IP-42/IP52 respectively. These shall be suitable for surface or flush mounting as specified outdoor lighting panel shall be weather protected and shall also has necessary canopy. Panels shall be equipped with phase and neutral bus bars of adequate capacity and miniature circuit breakers/RCCB of 10 kA capacities for the incoming and outgoing circuits as specified in panel schedule.

Miniature circuit breakers shall be mounted in such a way that operating levers project outside the top Bakelite cover plates. A hinged lockable door to cover the operating knobs shall be provided. In addition panels shall be provided with grounding studs and an engraved name plates etc as per the panel schedule. An earth bus shall be provided. Each circuit phase neutral shall be given ferrule numbers.
Complete wiring inside the panel shall be neatly bunched with PVC tape and button. For the outgoing circuits of these panels cable glands, plates, knock outs or conduit entry shall be provided as specified on panel schedule.
All metal surfaces shall be cleaned free of rust and given two coats of approved paints by powder coated point. Panels shall be walls mounting type having arrangement of mounting frame.

SWITCHES: Switches, manufactured in accordance with IS; 3854 shall be used. Switches in are as where concealed wiring has been adopted shall be flush mounting piano plate type unless otherwise specified. In other areas, the switches shall be toggle types.

CEILING ROSE & LAMP HOLDERS

All ceiling Rose and holders shall be ISI marked. Ceiling Rose shall be plate type and lamp holders shall be suitable for BC.
A ceiling rose shall be used on a circuit, the voltage of which normally not exceeding 250V. Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.
A ceiling rose shall not embody fuse terminal as an integral part of it.

RECEPTACLES

Only three-pin type receptacles manufactured in accordance with IS; 1293 shall be used with the third terminal connected to the earth. All receptacles shall be provided with a switch mounted on the same enclosure but shall be a separate unit to facilitate replacement by part. Flush mounting type receptacles adopted and surface type shall be used in other areas.

OUTLET BOXES

Outlet boxes for sockets, switches, fixtures and fan regulators etc shall be for minimum 16 gauge. M.S. sheet 3" deep with necessary modular plate for mounting switch, sockets etc.

WIRES

Wires shall be ZHFR PVC insulated 660/1100 Volts grade as per IS; 1554 Conductor shall be of stranded copper and size shall be (min.1.5mm^2) for lighting and (min 2.5mm^2) for power socket circuits. Red/Yellow/Blue wires for Phases, Black wire for Neutral and Green wire for Earth shall be used. Wiring in conduits without colour coding is not acceptable. The lighting layouts furnished by consultant shall indicate approx. locations of lighting fixtures. The electrical contractor shall determine, with approval of the consultant or his authorized representative. The exact locations of each fixture in order to avoid interference with mechanical equipment & also with a view to obtain as uniform illumination as practicable, & to avoid objectionable shadows. Conduit run shown on drawing is only indicative. These shall be laid out by the contractor to suit field conditions.
The cost for cable clamps, metal spacers, anchor bolts etc. shall be deemed to have been included in the installation.

HALOGEN FREE FLAME RETERDANT Single Core Flexible Copper Cables, having high Current Rating for Voltages up to 1100 Volts A.C. shall be used having the following features:

Conductor: Many thin strands of Electrolytic Copper are to be fine -drawn simultaneously for uniformity of characteristics, such as Resistance, Dimensions, flexibility etc. The drawn strands are to be collected and closely twisted in high precision machines and further compacted. This will not only impart circularity to the bunched conductors, but also prevents the tendency for the strands to separate and exert internal pressure on the insulation when the cable is bent during installation and usage.
Insulation : Specially formulated high temperature grade of Flame Redraft Low Smoke compound restricts the spread of flame in the fire situation. The smoke emitted by the burning cable is also less as

compared to traditional cables. This offers improved visibility for evacuation of trapped victims and facilitates fire fighting operation.

Marking: The cables are to be printed with generic marking .

Colours: Entire cable shall have white base and a double strip of Red, Yellow, Blue, Black, Green running along the length of the Cable.

Properties	**Test Method**	**Value**
Limited Oxygen Index	ASTM – D2863	31%
Temperature Index	ASTM – D2863	>250^{O} C
Smoke Density (Light absorption)	ASTM – D2843	<55%

Specifications generally confirm to : IS 694, IEC 60332-1, IEEE 383, IEC 754-1, BS 4066-1, DIN VDE 0281-3 Size, Dimensions and Ratings:

Conductor Area Sq. MM	Insulation Thickness mm	Configuration	Max Overall Diameter mm	Conductor Resistance Ohm/km @20^{O}C (Max)	Current Rating Amps	
					Casing	Concealed
1.00	0.6	14/0.3	3.2	18.1	14	13
1.50	0.7	22/0.3	3.4	12.1	18	16
2.50	0.8	36/0.3	4.2	7.41	24	20
4.00	0.8	56/0.3	4.8	4.95	32	26

SURFACE CONDUIT SYSTEM

Surface conduit 25mm 16SWG ms conduit /25 mm medium thickness M.S conduit system of wiring shall be adopted, wherever specified in the drawings, Suitable pull boxes or inspection type fittings will be used be used to facilitate drawing wires.

Confirming to IS 3419 & IS 9537(Part –3).

CONCEALED CONDUITING & WIRING

1. Concealed conduiting shall be carried out by medium thick min 25mm diameter rigid M.S conduit embedded in RCC/brick work with normal accessories like junction boxes, shall also be of same material that of conduit. Only deep junction boxes shall be used for concealed conduit installation. All junction boxes shall be of ample size to permit the wires to be drawn in and out.

2. Concealed conduits shall be securely fixed to prevent movement during building operation viz. casting of concrete fixing shall be by means of clips or other approved manner so as to ensure that there will no damage or deformation to conduits.

3. Conduits installed in chases of wall shall be firmly secured by `U' nails and such fixing shall be adequate to hold the pipes by themselves with chicken mesh covering.

4. Recessed conduits buried in plaster shall permit a full 6mm depth of cover over its entire length.

5. When conduits are laid in slabs or shuttered walls, the contractor shall arrange a competent person to be in attendance while the concrete pouring operation is being carried out in order to avoid damage being caused to conduits and also to ensure that the conduit work is in sound condition and properly and efficiently maintained during installation period.

6. To prevent water dirt or rubbish entering the conduit system during erection plugs shall be utilized.

7. All bends shall be made utilizing bending spring with the help of heater. The bends shall belong bends to avoid deformation of conduits with necessary couplers where conduits cross expansion joints of the building structure special expansion couplings shall be used or other approved methods adopted.
8. The minimum diameter of otherwise specified with medium thickness.

9. Wiring shall be carried out with stranded copper conductor PVC insulated colour coded wires conforming to IS 694

10. No joints shall be permitted and wires shall be looped from point to point. Wiring shall maintain colour code for phases neutral (R, Y, B and black) and green for earthing. The earth wire also shall be drawn inside the conduit and shall be continuous.

11. At all terminations of wires, the insulation shall be neatly stripped without damaging the conductor. In no case shall bear conductors are allowed to project beyond any insulated shrouding or molding of live terminals.

12. Installation of terminal blocks will be permitted only where wires can't be terminated directly on terminals in appliances. Connectors should be properly fixed inside box. Unfixed connectors will not be permitted.

13. The preferred conduit size and capacity of wires shall be as detailed below.

	SIZE OF WIRE FR		
Size of Conduit	1.5 mm²	2.5 mm²	4 mm²
25 mm	10	7	6
32 mm	15	12	8
38 mm	17	15	10

14. The size of wires for different circuits will be as per BOQ, but generally as follows.
Lighting points and 5A sockets - 1.5 mm².
Circuit wiring/primary point/two or three 5A sockets - 2.5 mm². AC / Geyser - 4 mm².
Earthing wire shall be min 1.5 mm² or half of the size of phase wire.

15. Switch socket boxes. The switch socket boxes shall be of sheet steel. The min thickness of the sheet shall be 2mm. The box shall be thoroughly cleaned of grease and rust. The paintings shall be two coats of primer followed by two coats of enamel paint. All boxes shall be provided with earthing terminal. The boxes shall be provided adequate knock out for connection conduits. Proper grouting in the wall / partition will be carried out as directed by consultant/ architect. All boxes shall be provided with accessories like plates, mounting arrangements.

16. Switches and Sockets

Local switches shall be provided for controlling lighting equipment connected to sockets. All sockets shall be 2-pin and earth type unless otherwise stated. Sockets for AC unit geysers shall be metal clad types unless other wise stated.

17. In case of false ceiling employing minimum tee grid system, fixtures shall be supported from true ceiling. Exact locations of fixtures shall be finalized in consolation with air conditioning contractors and as indicated on architectural drawings. Wiring above false ceilings shall be left loose in flexible pipe and shall be supported along structures/ceiling. Wiring above false ceiling shall be on surface and below false ceiling it shall be concealed. To facilitate easy maintenance looping back system of wiring shall be followed throughout. Accordingly supply tapings and other interconnections are made only at fixture connector blocks or at switchboards. Intermediate junction boxes shall be used for wire pulling as inspection boxes. All wires in conduit shall be colour as specified. Each circuit shall have independent phase neutral and earth wire. Unless otherwise specified, insulated conductors of ac supply and dc supply shall be bunched in separate conduits.

EARTHING 1. The earthing installation shall be done in accordance with the earthing drawings, Specifications and the standard drawings of reference attached with this document. The entire earthing system shall fully comply with the Indian Electricity Act and Rules framed thereunder. Typical plate type earthing comprises of excavation up to depth of 3.2mtr, Earthing Plate along with earthing risers installation, , charcoal. Salt treatment, watering pipe, Iron funnel with wire mesh, brick masonry chamber, cast iron lockable manhole cover, earthing link etc.
The contractor shall carryout any changes desired by the electrical Inspector or the owner, in order to make the installation conform to the Indian Electricity Rules at no extra cost. The exact location of earth conductor s, earth electrodes and earthing points on the equipment shall be determined in field, the consultation with the consultant or his authorized representative. Any changes in the methods, routing, size of conductor etc shall be subject to approval of the consultants. Earthing pit shall be preferably 2mtr. away from building and other earth pit.

2. Excavation and backfilling of earth, necessary for laying underground earth bus loops shall be the responsibility of the contractor and at no extra cost.

3. The earth loop impedance to any point in the electrical system shall have a value, which will ensure satisfactory operation of protective devices.
4. The main earth loops shall be laid at depth of 500mm below grade level. In cable trenches shall be firmly cleated to the walls of concrete lined trenches. The earthing strip shall be protected against mechanical damage.

5. Joint and tapings in the main earth loop shall be made in such a way that reliable and good electrical grade shall be welded and suitably protected by giving two coats of bitumen and covering with Hussein tape. All joints above ground shall be by means of connectors/ lugs as far as practicable. Tee connectors shall be used for tapping, earth leads from the main earth loops wherever it is installed above ground. Earthing plates as shown shall be provided for earthing of two or more equipment at a place from earth grid. This GI Riser shall be protected applying two coats of bituminous painting/bitumen on the exposed portion.

DEDICATED EARTHING

For UPS, V-Sat antenna earthing is taken from Dedicated Earthing Pit. Earthing Pit shall be same as mentioned above. Only the earth conductor shall be 8 SWG single strand insulated copper wire or as mentioned, taken through conduit up to earth busbars. Earthing for computer, UPS and Antenna shall be done through this earth bus.

CONNECTION

All electrical equipment is to be doubly earthen by connecting two points on equipment to earthing several earth electrodes. The earth grid formed shall be a closed loop as shown in the drawing with earth electrodes connected to the grid with double strip connection. Panels, D.B.s, Conduit trays/steel structured in which cable has been installed, shall be effectively bonded and earthen. Cable armors shall be earthen at both ends.

TESTING

1. Measure the insulation resistance of each circuit without the lamps (load) being in place and it should be more than one M-ohms to earth. The insulation resistance measured as above shall not be less than 50 divided by the number of points on the circuit provided on the circuit provided that the whole installation shall not be required to have an insulation greater than one megohms.

2. Check the earth continuity for all socket outlets. A fixed relative position of the phase and neutral connections inside the socket shall be established for all sockets.

3. The insulation resistance between the case of framework of housing and power appliances and all live parts of each appliance shall not be less than that specified in the relevant Indian Standard Specifications.

4. On completion of cable laying work the Insulation Resistance (Sectional and overall), Continuity Resistance test, Sheathing continuity test, Earth Test., shall be conducted.

5. Checking the operation of all devices, as ACBs, MCCBs Emergency stops, etc.
6. Voltage, Current, Wattage, Power factor parameter checking at each Panel and DB level to ensure no overloading.

1. Neutral to earth voltage at all UPS DB and socket level.

2. Polarity test at UPS socket level.

3. Earth testing and Earth continuity.

4. Integrated testing of entire facility.

COMMISSIONING

1. The contractor shall obtain the written permission and sanction of commissioning the equipment from Electrical Inspector of I. E. & L. Department of State Government and Supply authority. If required under the specific rules of the Government.
2. Current and voltage of all the phases shall be measured at the lighting panel busbars with all the circuits switched on with lamps, if required load shall be balance on the three phases.
3. After inserting all the lamps and switching on all the circuits minimum and maximum illumination level should be measured in the area.

ENGINEERING SPECIFICATION – INTELLIGENT FIRE ALARM SYSTEM

PART 1.0 – GENERAL

1.1 DESCRIPTION:

A. This section of the specifications includes the furnishing, installation, and connection of the microprocessor controlled, addressable reporting fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, fire alarm control panel, auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

B. The fire alarm system shall comply with requirements of NFPA standard No. 72 for protected premises signaling systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

1.2 SCOPE:

A. A new addressable reporting, microprocessor controlled fire detection system shall be installed in accordance with the specifications and drawings. B. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent addressable reporting devices shall be encoded onto a Class B (NFPA Style 4), or Class A (NFPA Style 6, 7) Signaling Line Circuit (SLC).
2. Initiation Device Circuits (IDCs) shall be wired Class B (NFPA Style B) or Class A (NFPA Style D).
3. Notification Appliance Circuits shall be wired Class B (NFPA Style Y) or Class A (NFPA Style Z).
4. Built-in Horn Strobe Synchronization w/ selective silence.
5. Digitized electronic signals shall employ check digits or multiple polling.
6. A single ground or open on the system Signaling Line Circuit (SLC) shall not cause system malfunction, loss of operating power or the ability to report an alarm.
7. Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

C. Basic System Functional Operation

When a fire alarm condition is detected and reported by one of the system initiating devices the following functions shall immediately occur:

1. The System Alarm LED shall flash.
2. A local piezo electric signal in the control panel shall sound.
3. A 80-character, backlit LCD display shall indicate all information associated with the Fire Alarm condition, including the type of alarm point and its location within the protected premises.
4. Printing and history storage equipment shall log the information associated with each new Fire Alarm Control Panel condition, along with time and date of occurrence.
5. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated System Outputs (alarm Notification Appliances and/or Relays) shall be activated.

1.3 SUBMITTALS

A. General:

1. Two copies of all submittals shall be submitted to the Architect/Engineer for review.
2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent equipment (compatible UL- Listed) from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
3. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. B. Shop Drawings:
1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show remote annunciator(s) layout, configurations, and terminations. C. Manuals:
1. Submit simultaneously with the shop drawings, complete operating and maintenance manual listing the manufacturer's name(s) including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. D. Certifications:
Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4 GUARANTEE:
All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one-year period shall be included in the submittal bid.

1.5 MAINTENANCE:
Maintenance and testing shall be on a semi-annual basis or as required by the local AHJ. A preventive maintenance schedule shall be provided by the Contractor that shall describe the protocol for preventive maintenance. The schedule shall include:
1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow switches and all accessories of the fire alarm system.
2. Each circuit in the fire alarm system shall be tested semi-annually.
3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.

1.6 POST CONTRACT EXPANSIONS:
A. The contractor shall provide parts and labor to expand the system specified, if so requested, for a period of one (1) year from the date of acceptance.
B. As part of the submittal include a quotation for all parts and material, and all installation and test labor as needed to increase the number of addressable devices by ten percent (10%). This quotation shall

include addressable smoke detectors, addressable heat detectors, addressable duct detectors, addressable manual stations, addressable monitor modules and addressable control modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).

C. Quotation shall include installation and test labor and labor to reprogram the system for this 10% expansion. If additional FACP hardware would be required, include the material and labor necessary to install this hardware.

D. Submittals that do not include this estimate of post contract expansion cost will not be accepted.

1.7 APPLICABLE SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with these standards.

A. National Fire Protection Association (NFPA) - USA: No. 70 National
Electrical Code (NEC)
No. 72 Central Station Signaling
Systems No. 72 Protective
Signaling Systems
No. 72 Automatic Fire Detectors
No. 72 Notification Appliances for Protective Signaling Systems.
No. 72 Testing Procedures for Signaling Systems.
No. 101 Life Safety Code

B. Underwriters Laboratories Inc. (UL) - USA:
No. 268 Smoke Detectors for Fire Protective Signaling Systems
No. 864 Control Units for Fire Protective Signaling Systems
No. 268ASmoke Detectors for Duct Applications.
No. 521 Heat Detectors for Fire Protective Signaling Systems
No. 464 Audible Signaling
Appliances.
No. 38 Manually Actuated Signaling Boxes.
No. 346 Waterflow Indicators for Fire Protective Signaling
Systems. No. 1971Visual Notification Appliances for the
hearing impaired.

C. Local and State Building Codes

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.8 APPROVALS:

The system shall have proper listing and/or approval from the following nationally recognized agencies:

- UL Underwriters Laboratories Inc.
- FM Factory Mutual Systems
- CSFM California State Fire Marshal
- MEA NYC Materials and Equipment Acceptance
- ULC Underwriters Laboratories of Canada

PART 2.0 PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All Equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings).
Fasteners and supports shall be adequate to support the required load.

D. Equipment should be manufactured by an ISO 9001 Certified Company.

2.2 CONDUIT AND WIRE:

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
2. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.
4. Wiring for 24 volt control, alarm notification, emergency communication and similar power limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the Fire Alarm Control Panel, or any other remotely mounted Control Panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4-inch (19.1 mm) minimum.

B. Wire:

1. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.
2. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
3. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
4. Wiring used for the multiplex communication loop shall be twisted and shielded and installed in conduit unless specifically excepted by the fire alarm equipment manufacturer. The system shall permit use of IDC and NAC wiring in the same conduit with the communication loop.
5. All field wiring shall be completely supervised.

C. Terminal Boxes, Junction Boxes and Cabinets:

D. All boxes and cabinets shall be UL listed for their use and purpose.

E. The Fire Alarm Control Panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the Main Power Distribution Panel as FIRE ALARM. Fire Alarm Control Panel Primary Power wiring shall be 12 AWG. The Control Panel Cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2.3 MAIN FIRE ALARM CONTROL PANEL:

A. The FACP shall be a Fire-Lite Alarms model MS-9600 and shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: addressable detectors, addressable modules, printer, annunciators, and other system controlled devices.

B. System Capacity and General Operation

1. The control panel shall provide, or be capable of expansion to 318 addressable detectors and 318 monitor or control modules (636 addressable devices).
2. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit, 80-character Liquid Crystal Display, individual, color coded system status LEDs, and an alphanumeric keypad for the Field Programming and control of the Fire Alarm System.
3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the Fire Alarm Control Panel.
4. The FACP shall provide the following features: Maintenance Alert to warn of excessive detector dirt or dust. Detector sensitivity read/test information and System Status Reports to display or print. Smoke Detector Alarm Verification. Pre-signal, meeting
NFPA 72 requirements. Rapid manual station reporting (under 3 seconds). Periodic Detector Test, conducted automatically by the control panel every two hours. March time, temporal (ANSI Cadence) and California Code coding options. Walk Test will check for two detectors set to same address.
5. The main CPU shall contain Form-C relay contacts rated at 2.0 amps/30VDC for the following: Alarm, Trouble, Supervisory.
6. The CPU shall contain two Class B or A (NFPA Style Y or Z) programmable Notification Appliance Circuits.

C. Central Microprocessor

1. The Microprocessor shall communicate with, monitor, and control all external interfaces with the control panel. It shall include EPROM for system program storage; non-volatile memory for building-specific program storage; and a "watch dog" timer circuit to detect and report microprocessor failure.
2. The Microprocessor shall contain and execute all programming for specific action to be taken if an alarm condition is detected by the system. Such programming shall be held in non-volatile programmable memory and shall not be lost if both the system primary and secondary power failure occurs.
3. he Microprocessor Unit shall also provide a Real- Time Clock for time annotation of system displays, printer, and history file.

4. The Microprocessor Unit shall contain flash memory capabilities for easy upload/download for upgrades of software.
5. All clock, date and history files shall be maintained during power loss.

D. Display
1. The Display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.
2. The Display shall include status information and custom alphanumeric labels for all Addressable Detectors, Addressable Modules and Software zones.
3. The Display shall provide a 80-character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide 9 Light-Emitting-Diodes (LEDs), consisting of and not limited to the following: AC POWER, FIRE
ALARM, SUPERVISORY, SYSTEM TROUBLE, MAINTENANCE, ALARM SILENCED, DISABLED, BATTERY, and GROUND.
4. The Display shall provide a 25-key touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
5. The Display shall include the following operator switches: ACKNOWLEDGE/STEP ALARM SILENCE, DRILL, and SYSTEM RESET (also serving as a lamp test switch).

E. Signaling Line Circuit Interface
1. The SLC Interface shall provide power to, and communicate with, all of the Addressable Detectors and Addressable Modules over a single pair of wires. This SLC Loop shall be capable of NFPA Style 4, Style 6, or Style 7 operation.
2. The SLC interface shall receive information from all Addressable Devices. This information shall be processed to determine whether normal, alarm, or trouble conditions exist for each detector. This information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
3. The Signaling Line Circuit shall be capable of distances of 10,000 feet (@ 12 AWG, twisted). For retrofit applications, the system shall support up to 3,000 feet of untwisted, unshielded wire. (Loop 1 only)

F. Serial Interfaces
1. An EIA-232 interface between the Fire Alarm Control Panel and UL Listed Electronic Data Processing (EDP) peripherals shall be provided. The EIA-232 interface shall allow the use of printers, or for an interface to an off-line PC programmer.
2. An EIA-485 port shall be available for the serial connection of optional remote led-type annunciators. EIA- 485 in terminal mode shall allow serial connection of optional LCD, English language remote system displays. LED (per zone or point) annunciators shall also be provided. The maximum distance to the furthest annunciator shall be 3,000 feet. The system shall support a maximum of 32, remote annunciators on a single twisted, shielded pair. The maximum distance to the furthest annunciator shall be 6,000 feet.
3. A PS2/PC keyboard connection shall be provided to support the connection of a PC keyboard for local programming of the fire alarm system.

G. Enclosures:

1. The control panel shall be housed in a UL listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected.

2. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.

3. An optional semi-flush trim ring shall be available for a neat cabinet dress.

H. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.

I. Optional plug-in modules shall be provided for NFPA 72 auxiliary and remote station fire alarm systems as well as a Digital Alarm Communicator Transmitter for NFPA 72 Central Station systems. The DACT (Fire-Lite Alarms model UDACT) shall meet all current UL requirements for delayed AC fail reporting and shall be capable of reporting individual signals for all 636 points.

J. Optional modules (Fire Lite Alarms model ACM-8RF) shall provide eight Form-C relays rated at 5.0 amps (Relays shall track programmable software zones) and (Fire-Lite Alarms model 4XTMF) Municipal box connection and reverse polarity connection.

K. Power Supply:

1. The Power Supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.

a. 240 VAC, 50 Hz version shall be available where required.

2. It shall provide a minimum of 6.0 amps of usable Notification Appliance power.

3. It shall provide a battery charger for 24 or 60 hours of standby using dual-rate charging techniques for fast battery recharge.

4. It shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults on sensitive addressable modules.

5. It shall be power-limited using fuse-less, quick-acting electronic circuitry meeting the latest UL requirements.

L. Operators Controls

1. Acknowledge Switch:

a. Activation of the control panel Acknowledge switch in response to new Alarms and/or Troubles shall silence the local panel piezo electric signal and change the Alarm and Trouble LEDs from flashing mode to steady-ON mode. If multiple Alarm or Trouble conditions exist, depression of this switch shall advance the 80-character LCD display to the next Alarm or Trouble condition.

b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Signal Silence Switch: Activation of the Signal Silence Switch shall cause all programmed Notification Appliances and relays to return to the normal condition after an alarm condition. The selection of Notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit, auto-silence timers, and an option to silence horns and keep strobes flashing.

3. System Reset Switch: Activation of the System Reset Switch shall cause all electronically latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition. Holding the RESET switch shall perform a Lamp Test function.
4. Drill (Evacuate) Switch: Press and hold of the Drill switch shall activate all Silenceable Notification Appliance circuits. The Drill function shall latch until press of Signal Silence or Reset.

M. Printer

A printer may be connected to provide hard-copy printout of all changes in status of the system and shall time-stamp such printouts with the current time-of-day and date. The printer shall communicate with the control panel using an interface complying with Electrical Industries Association standard EIA-232D.

N. Field Programming

1. The system and its respective devices (i.e. smoke detectors and modules) shall be programmable, configurable and expandable in the field without the need for special tools or electronic equipment and shall not require field replacement of electronic integrated circuits.
2. All programming may be accomplished through the standard FACP built-in keypad. As well through using a PC keyboard (connection provided on UNIMODE-9600 main circuit board.)
3. All field-defined programs shall be stored in non-volatile memory and shall not be lost if AC mains and/or battery is lost.
4. The programming function shall be enabled with a password that may be defined specifically for the system when it is installed. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level is used for status level changes such as zone disable or manual on/off commands. A second (higher-level) is used for actual change of program information.
5. Program edit shall not interfere with normal operation and fire protection. If a fire condition is detected during programming operation, the system shall exit programming and perform fire protection functions as programmed.
6. A special program check function shall be provided to detect common operator errors.
7. An Auto-Program (self-learn) function shall be provided to quickly program initial functions within several seconds. During this operation, smoke detectors connected to the Signaling Line Circuit shall be automatically installed without labor intensive operator key commands and the using additional electronic equipment to program each individual detector.
8. For flexibility, an optional off-line programming function, with batch upload/download, shall also be available.

O. Specific System Operations

1. Alarm Verification: The Fire alarm control panel shall have the ability to alarm verify addressable smoke detectors.
2. Point Disable: Any device in the system may be Enabled or Disabled through the system keypad.
3. Point Read: The system shall be able to display or print the following point status diagnostic functions: a. Device Status, b. Device Type, c. Device Label, d. Device Zone Assignments and e. Program Parameters
4. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.

5. Device Sensitivity Reports: Upon command from the operator, the detectors sensitivity can be read and results printed

6. System History Recording and Reporting: The Fire Alarm Control Panel shall contain a History Buffer that will be capable of storing up to 1,000 system alarms, troubles, or operator actions.

7. Automatic Detector Maintenance Alert: The Fire Alarm Control Panel shall automatically interrogate each Addressable Smoke Detector and shall analyze the detector responses over a period of time. If any addressable Smoke Detector in the system responds with a reading that is below or above normal limits, then the system will enter the Trouble Mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

8. Software Zones: The FACP shall provide 99 software zones. All addressable devices may be field programmed, to be grouped into these zones for control activation and annunciation purposes. Systems that utilize limited programmability, such as general alarm operation, are unacceptable.

2.4 SYSTEM COMPONENTS:

A. Programmable Electronic Sounders

1. Electronic sounders shall operate on 24 VDC nominal.

2. Electronic sounders shall be field programmable without the use of special tools, to provide slow whoop, continuous, or interrupted tones (Temporal Pattern) with an output sound level of at least 90 dBA measured at 10 feet from the device.

3. Shall be flush or surface mounted as shown on plans. B. Strobe Lights:

1. Shall operate on 24 VDC nominal.

2. Shall meet the requirements of the ADA (Americans with Disabilities Act) as well as UL Standard 1971.

C. Audible/Visual Combination Devices:

1. Shall meet the applicable requirements of Section A listed above for audibility.

2. Shall meet the requirements of Section B listed above for visibility.

D. Addressable Manual Pull Box (Fire-Lite Alarms model BG-12LX)

1. Addressable Manual Stations shall be provided to connect to the Fire Alarm Control Panel Signaling Line Circuit (SLC) Loops. Up to 159 addressable manual stations may be connected to each SLC loop.

2. The Manual Pull Box shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. Manual Fire Alarm Stations shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

3. All operated stations shall have a positive, visual indication of operation that cannot be reset without the use of a key.

4. Manual Stations shall be constructed of LEXAN (or polycarbonate equivalent) with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger.

5. Stations shall be suitable for surface mounting, or semiflush mounting as shown on the plans, and shall be installed in accordance with ADA and local codes.

6. The Manual Station shall provide address-setting means using decimal switches. Addressable manual stations that use binary address setting methods, such as a dip switch, are much more difficult to install and are subject to installation error, and are not allowable substitutes.

E. Addressable Photoelectric Detectors (Fire-Lite Alarms model SD350)

1. Smoke detectors shall be addressable and shall connect with two wires to the Fire Alarm Control Panel Signaling Line Circuit. Up to 318 addressable detectors may connect to two seperate SLC loops.
2. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density.
3. The detectors shall be low profile ceiling-mount and shall include a twist-lock base.
4. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel.
5. The detectors shall provide address-setting means on the detector head using decimal switches. Because of the possibility of installation error, systems that use binary jumpers on dipswitches to set the detector address are not acceptable. The detectors shall also store an internal identifying code that the control panel shall use to identify the type of detector.
6. The detectors shall provide an alarm and power LED. The LED shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. The LED is placed into steady illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED (Fire-Lite Alarms model RA400Z).

F. Addressable Photoelectric Detectors with Fixed Thermal Sensor (Fire-Lite Alarms model SD350T)

1. Smoke detectors shall be addressable and shall connect with two wires to the Fire Alarm Control Panel Signaling Line Circuit. Up to 318 addressable detectors with fixed thermal sensors (135 degree F) connect to two SLC loops.
2. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density.
3. The detectors with fixed thermal sensors shall alarm at a fixed temperature of 135 degree F.
4. The detectors shall be ceiling-mount and shall include a twist-lock base.
5. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel.
6. The detectors shall provide address-setting means on the detector head using decimal switches. Because of the possibility of installation error, systems that use binary jumpers on dipswitches to set the detector address are not acceptable. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. The detectors shall also store an internal identifying code that the control panel shall use to identify the type of detector.
7. The detectors shall provide an alarm and power LED. The LED shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. The LED is placed into steady illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED (Fire-Lite Alarms model RA400Z).

G. Addressable Ionization Smoke Detectors (Fire-Lite Alarms model CP350)

1. Smoke Detectors shall be low profile addressable and connect with two wires to the Fire Alarm Control Panel Signaling Line Circuit. Up to 318 addressable detectors may connect to two SLC loops.
2. The detectors shall use the dual-chamber ionization principal to measure products of combustion.
3. The detectors shall be low profile ceiling-mount and shall include a twist-lock base.
4. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by activating a switch, or may be activated remotely on command from the control panel.
5. The detectors shall provide address-setting means on the detector head using decimal switches. Because of the possibility of installation error, systems that use binary jumpers or dipswitches to set the address are not acceptable. They shall also store an internal identifying code that the control panel shall use to identify the type of detector.
6. The detectors shall provide an alarm and power LED. The LED shall flash under normal conditions. The LED is placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect a remote alarm LED (Fire-Lite Alarms model RA400Z).

H. Addressable Monitor Module (Fire-Lite Alarms model MMF-300)
1. Addressable Monitor modules shall be provided to connect one supervised IDC (zone) of conventional Alarm Initiating Devices (any N.O. dry contact device) to the Fire Alarm Control Panel Signaling Line Circuit (SLC) Loop. 2. The monitor module shall mount in a 4-inch square, 2-1/8" deep electrical box.
3. The IDC (zone) may be wired for Style D (Class A) or Style B (Class B) operation. The Monitor module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the Fire Alarm Control Panel shall use to identify the type of device. Modules that use binary jumpers or dip-switches are subject to installation errors and are not acceptable. An LED shall be provided that shall flash under normal conditions, indicating that the Monitor module is operational and in regular communication with the control panel.
4. For difficult to reach areas, the Monitor Module shall be available in a miniature package and shall be no larger than 2-3/4"W x 1-1/4"H x 1/2"D (Fire-Lite Alarms model MMF-301). This version does not support Style D operation or include an LED.

I. Addressable 2-Wire Smoke Detector Monitor Module (Fire-Lite Alarms model MMF-302)
1. Addressable 2-Wire Smoke Detector Monitor Modules shall be provided to connect one supervised IDC (zone) of two-wire conventional smoke detectors to the Fire Alarm Control Panel Signaling Line Circuit (SLC) Loop.
2. The monitor module shall mount in a 4-inch square, 2-1/8" deep electrical box.
3. The monitor module shall provide terminal connections for a resettable external supply voltage to provide power to the IDC (zone) of two-wire smoke detectors.
4. The IDC (zone) may be wired for Style D (Class A) or Style B (Class B) operation. The monitor module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the Fire Alarm Control Panel shall use to identify the type of device. Modules that use binary jumpers or dip-switches are subject to installation errors and are not acceptable. An LED shall be provided that shall flash under normal conditions, indicating that the Monitor module is operational and in regular communication with the control panel.

J. Addressable Dual-Circuit Monitor Module (Fire-Lite Alarms model MDF-300)

1. Addressable Dual-Circuit Monitor Modules shall be provided to connect two supervised IDCs (zones) of conventional Alarm Initiating Devices (any N.O. dry contact device) to the Fire Alarm Control Panel Signaling Line Circuit (SLC) Loop.
2. The-monitor module shall mount in a 4-inch square, 2-1/8" deep electrical box.
3. The IDCs (zones) may be wired for Style B (Class B) operation only. The Monitor module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the Fire Alarm Control Panel shall use to identify the type of device. Modules that use binary jumpers or dip- switches are subject to installation errors and are not acceptable. An LED shall be provided that shall flash under normal conditions, indicating that the Monitor module is operational and in regular communication with the control panel.

K. Addressable Control Module (Fire-Lite Alarms Model CMF-300)

1. Addressable Control Modules shall be provided to supervise and control the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual appliances or audio speakers.
2. The Control Module shall mount in a standard 4-inch square, 2-1/8" deep electrical box or to a surface mounted backbox.
3. The NAC shall wire in a Class B (Style Y) or Class A (Style Z) fashion. Each control module shall support up to 1 Amp of Inductive or 2 Amps of Resistive Audible/Visual signals.
4. Audio/Visual power shall be provided by a separate supervised power Loop from the main Fire Alarm Control Panel or from a supervised, UL listed Remote Power Supply.
5. The Control Module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the Control Panel shall use to identify the type of device. Modules that use binary jumpers or dip-switches are subject to installation errors and are not acceptable. An LED shall be provided that shall flash under normal conditions, indicating that the Control Module is operational and is in regular communication with the control panel.
6. A magnetic test switch shall be provided to test the module without opening or shorting its NAC circuit wiring.

M. Addressable Relay Module (Fire-Lite Alarms model CRF-300)

1. Addressable Relay Modules shall be provided to allow a compatible control panel to switch discrete contacts by code command.
2. The Relay Module shall mount in a standard 4-inch square, 2-1/8" deep electrical box or to a surface mounted backbox.
3. The Relay Module shall provide two isolated sets of Form-C contacts for fan shutdown and other auxiliary control functions.
4. The Relay Module contact ratings shall support up to 1 Amp/30 VDC of Inductive load or 2 Amps/30VDC (coded) of Resistive load (up to 3 Amps in non-coded applications). The relay coil shall be magnetically latched to reduce wiring connection requirements and to insure that 100% of all auxiliary relays or may be energized at the same time on the same pair of wires.
5. The Control Module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the Control Panel shall use to identify the type of device. Modules that use binary jumpers or dip-switches are subject to installation errors and are not acceptable. An LED

shall be provided that shall flash under normal conditions, indicating that the Control Module is operational and is in regular communication with the control panel.

6. A magnetic test switch shall be provided to test the module without opening or shorting its NAC circuit wiring.

N. Isolator Module (Fire-Lite Alarms model I300).

1. Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop. At least one isolator module shall be provided for each floor or protected zone of the building.

2. If a wire-to-wire short occurs, the Isolator Module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section of the SLC loop.

3. The Isolator Module shall not require any address setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an Isolator Module after its normal operation.

4. The Isolator Module shall mount in a standard 4-inch deep electrical box or in a surface mounted backbox. It shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

O. Waterflow Switches (System Sensor WFD Series)

1. Flow switches shall be integral, mechanical, non-coded, non-accumulative retard type.

2. Flow switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds.

3. Flow switches shall be located a minimum of one (1) foot from a fitting that changes the direction of the flow and a minimum of three (3) feet from a valve.

P. Sprinkler and Standpipe Valve Supervisory Switches:

1. Each sprinkler system water supply control valve riser or zone control valve, and each standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.

2. Each Post Indicator Valve (PIV) or main gate valve shall be equipped with a supervisory switch.

3. Mount switch so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.

4. The mechanism shall be contained in a weatherproof aluminum housing, that shall provide a 3/4-inch tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.

5. Switch housing to be finished in red baked enamel.

6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.

7. Valve supervisory switches shall be provided and connected under this section and installed by mechanical contractor.

Q. Serial, LED-Type, Remote Annunciation (Fire-Lite Alarms AFM Series) 1. The annunciator shall communicate with the fire alarm control panel via an EIA 485 (ACS mode) communications loop and

shall annunciate all zones in the system. Up to 32 annunciators may be connected to the EIA 485 communications loop.

2. The annunciator shall need no more than four wires to connect to the FACP.

3. The annunciator shall provide a red Alarm LED per zone, and a yellow Trouble LED per zone. The annunciator will also have an "ON-LINE" LED, local piezo sounder, local acknowledge/lamp test switch, and custom zone/function identification labels.

4. The annunciator switches may be used for System control such as, Global Acknowledge, Global Signal Silence, and Global System Reset.

R. Serial, LCD-Type, Remote System Display (Fire-Lite Alarms LCD-80 Series)

1. The annunciator shall communicate with the fire alarm control panel via an EIA-485 (Terminal Mode) communications loop and shall include a 80-character, backlit, LCD display which mimics the integral fire alarm control panel LCD display. Up to 32 annunciators may be connected to the EIA-485 communications loop.

2. The annunciator shall require no more than four wires on the communication loop (two for communication, two for supervision) and two additional wires for power.

3. In addition to the LCD, English language display, the annunciator shall also include a Power LED, Alarm LED, Trouble LED and Supervisory LED.

4. A local piezo sounder shall also be included on the annunciator.

5. Switches for Acknowledge/Lamp Test, Silence, Drill and Reset shall be included on the annunciator protected from unauthorized usage by a key switch (keyed alike to the host FACP).

2.5 BATTERIES:

A. Shall be 12 volt, Gell-Cell type (two required).

B. Batteries (two required) shall have sufficient capacity to power the fire alarm system for not less than twenty- four hours plus 5 minutes of alarm upon a normal AC power failure.

C. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.

PART 3.0 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

3.2 TEST: Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
3. Verify activation of all flow switches.
4. Open initiating device circuits and verify that the trouble signal actuates.
5. Open and short signalling line circuits and verify that the trouble signal actuates.
6. Open and short Notification Appliance Circuits and verify that trouble signal actuates.
7. Ground all circuits and verify response of trouble signals.
8. Check presence and audibility of tone at all alarm notification devices.
9. Check installation, supervision, and operation of all addressable smoke detectors using the Walk Test.
10. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
11. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying the controls performance by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3 FINAL INSPECTION:
At the final inspection, a manufacturer-trained representative shall demonstrate that the system functions properly in every respect.

3.4 INSTRUCTION:
Provide instruction as required for operating the system. "Hands-on" demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided. The Contractor and/or the Systems Manufacturer's representatives shall provide a typewritten "Sequence of Operation" to the Owner if required.

A Public Address (PA) system amplifies and distributes sound to a large audience. Key technical specifications
include power output, frequency response, signal-to-noise ratio, and output impedance. The system comprises input sources (microphones, etc.), amplifiers, control & monitoring equipment, and loudspeakers. Specific requirements, like those for railway systems, can be found in documents like RDSO specification.

Detailed Specifications:

Power Output:

Measured in watts (e.g., 120W, 240W, 500W) per channel, with a specified total harmonic distortion (THD).

- **Frequency Response:**

The range of frequencies the system can reproduce, typically 40 to 20,000 Hz +1 dB, ensuring clarity for speech and music.

- **Signal-to-Noise Ratio (SNR):**

The ratio of the desired signal (voice, music) to background noise, expressed in decibels (dB). A higher SNR (e.g., 100dB) indicates a cleaner signal.

- **Output Impedance:**

The electrical resistance of the output circuit, often 100V or 70V for PA systems, influencing how the amplifier interacts with the loudspeakers.

- **Channel Separation:**

In multi-channel systems, the degree to which one channel's signal is isolated from others, measured in dB (e.g., 90dB at 1 kHz).

- **Controls and Indicators:**

Volume controls, power switches, LED indicators, and VU meters for monitoring and adjusting the system.

- **Grounding:**

Separate protective and operational grounding to minimize electrical interference, with a recommended grounding resistance not exceeding 1Ω, according to SPON Communications.

- **Software:**

PC control software with features for programming audio routing, amplifier levels, zone management, and monitoring system status.

- **Call Stations:**

Equipped with microphones and "push-to-talk" buttons for making announcements, with zoning capabilities for targeted messaging.

- **Intercom Functionality:**

Larger systems may include intercom features, like those found in railway applications, for communication between different personnel or areas.

- **Compliance:**

PA systems may need to comply with standards like IEC 60065 (for paging microphones) and IEC 60268 (for sound system equipment).

Additional considerations:

- **Zoning:** PA systems often divide the coverage area into zones for targeted announcements.

- **Background Music (BGM):** Some systems integrate background music playback.
- **Emergency Features:** PA systems may be integrated with fire alarm systems for voice evacuation, and they should be designed for reliability and self-recovery in case of failure.
- **Server:** In IP-based systems, the server must support protocols like SIP or equivalent, along with security features like firewalls.
- **Installation:** The system should be installed according to design specifications, with proper cabling and wiring.
- **Maintenance:** Regular maintenance and testing are essential for optimal performance.

NETWORKING SYSTEM (FOR DETAILING REFER BOQ) A network system's technical specifications define its architecture, components, and operational parameters. It details the hardware, software, protocols, and configurations necessary for devices to communicate and share resources effectively. Key aspects include network topology, communication protocols, transmission media, and security measures.
Here's a more detailed breakdown:

1. Network Topology:

- **Definition:** Describes the physical or logical arrangement of devices and connections within the network.
- **Examples:** Bus, star, ring, mesh, and tree topologies.
- **Specifications:** May include the number of nodes, connection types (wired/wireless), and the overall layout.

2. Communication Protocols:

- **Definition:** Rules and standards that govern how devices communicate and exchange data.
- **Examples:** TCP/IP, HTTP, FTP, SMTP, etc.
- **Specifications:** Details the protocols used for various functionalities, such as data transmission, routing, and application-level communication.

3. Transmission Media:

- **Definition:** The physical or wireless medium used to carry data between devices.
- **Examples:** Ethernet cables, fiber optic cables, Wi-Fi, Bluetooth.
- **Specifications:** Specifies the type of cables used, their lengths, and the wireless frequencies used.

4. Hardware Components:

- **Definition:** Physical devices that enable network functionality.
- **Examples:** Routers, switches, hubs, network interface cards (NICs), servers, and client devices.

- **Specifications:** Includes details about hardware specifications, such as port capacity, processing power, and storage capacity.

5. Software Components:

- **Definition:** Software that enables network operations and applications.
- **Examples:** Operating systems, network management software, security software.
- **Specifications:** Details the software versions, configurations, and required resources.

6. Security Measures:

- **Definition:** Mechanisms to protect network resources and data from unauthorized access.
- **Examples:** Firewalls, intrusion detection systems, encryption protocols.
- **Specifications:** Includes security policies, access control methods, and encryption algorithms.

7. Network Services:

- **Definition:** Services offered by the network, such as DHCP, DNS, and file sharing.
- **Specifications:** Details how these services are implemented, configured, and managed.

8. Performance Metrics:

- **Definition:** Measures that indicate the efficiency and effectiveness of the network.
- **Examples:** Throughput, latency, packet loss, and jitter.
- **Specifications:** Defines acceptable performance thresholds and monitoring procedures.

9. Scalability:

- **Definition:** The ability of the network to accommodate growth and changes in demand.
- **Specifications:** Includes provisions for expanding network capacity, adding new devices, and upgrading infrastructure.

By clearly defining these technical specifications, a network system can be designed, implemented, and maintained effectively, ensuring reliable and efficient communication and resource sharing.

DRAWINGS

Set of as built drawing shall be submitted to consultant after completion of job including drawings for the panels,
Distribution Boards, Circuit diagrams, single line diagrams, Electrical layout, Raceway layout, Junction Boxes used in Raceways, Conduit Layout, Cable layout, Location of Fire Detectors, Speakers, Emergency Circuits, etc..

SECTION–VI

LIST OF APPROVED BRANDS /MAKES OF EQUIPMENT REQUIRED UNDER THIS TENDER

The following are list of approved brands/makes of equipment required under this tender. Please note that wherever there is a multiple choice of brands/makes approved, only nominated brands/makes by consultant shall have to be supplied.

SR.NO	DISCRIPTION	MAKESOFMATERIAL
1	Air Circuit Breaker	Legrand/ Schneider/ L&T/ ABB
2	Moulded Case Circuit Breaker	Legrand/ Schneider/ L&T/ ABB
3	Switch Fuse Unit	Legrand/ Schneider/ L&T/ ABB/Honeywell
4	Miniature Circuit Breaker	Legrand/ Schneider/ L&T/ ABB
5	RCCB/RCBO	Legrand/ Schneider/ L&T/ ABB
6	Auto Transfer Switch	ASCO7000series
7	Meters	TRINITY/SCHNEIDER/ELMEASURE
8	LOAD MANAGERS	TRINITY/SCHNEIDER/ELMEASURE
9	Indicating Lamps LED	TEKNIC/L&T/SCHNIDER/SIEMENS
10	Selector Switches	L&T/SIEMENS/Schneider
11	Terminal Block	ELMEX/CLIPON/DLink
12	Metal Clad Sockets/ IEC Sockets	GERALD/RRPACE/LEGRAND
14	Distribution Boards	Legrand/ Schneider/ L&T/ ABB/Honeywell
15	APFCR Relay	TRINITY/L&T/Rudrashakti
16	Heavy Duty Capacitor	TRINITY/SCHNEIDER/ABB/CROMPTON
17	Cables	POLYCAB/ KEI/RR /Finolex
18	Lugs	DOWELL'S/BRACO/JAINSONS
19	GLANDS	SIEMENS/TYPEBRACO/COMET
20	FRLSPVC conduits ISI MARK	PRECISION/NATIONAL
21	MS Conduits & accessories	BEC/BI/VIMCO/GUPTA
22	Wires1100VGradeFRLSISIMARK	POLYCAB/KEI/RR/Finolex
23	PANEL MANUFACTURE	1) Arrow Electricals India Limited 2) VDHIK PANELS 3) Plasma Engineering India Limited
24	CO2 FLOODING SYSTEM	Kanex / Supremex / Rotarex Fire Tec
25	AHF	INSTASINE/TRINITY/SIEMENS/SCHNEIDER
26	Modular Switches ,Sockets ISI MARK	MK-Honeywell/ Legrand/ OBO OR AS PER APPROVAL OF SWAMI CONSULTANT

27	Screws	Any ISI Mark
28	Light Fittings	WIPRO/HAVELLS/PHILIPS
29	CABLETRAY/RACEWAYS/RACEWAYS JB	PRAKASH FABCOM / ENJAY INDUSTRIES
30	BUSDUCT	SCHNEIDER / GODREJ
31	CEILING FAN	CROMPTON/GEC
32	WALLMOUNTED FAN	CROMPTON/ALMONARD/GEC
33	NETWORKING	LEGRAND / SYSTIMAX / PANDUIT
34	FIRE ALARM SYSTEM	HONEYWELL (AS MENTION IN BOQ) / EDWARD / GST
35	PA SYSTEM	BOSCH /AHUJA /SONY
36	CCTV	Dvtel / Pelco / Bosch
37	NOVAC	SIEMENS / HONEYWELL / CYRPTO / STAR ELECTRONICS
38	WLD	SIEMENS / STAR ELECTRONICS
39	RODENT REPELLER	STAR ELECTRONICS / RSCAT / MASER

TECHNICAL SPECIFICATIONS FOR HVAC WORK

SCOPE OF WORK :

The Scope of Work will include (but not limited to) the following:

A. CHILLED WATER SYSTEM :

A.1 WATER COOLED CHILLED WATER SYSTEM COMPRISES OF :

1. 300 TR x 1 Nos. Water Cooled Screw Chillers.
2. 1 Nos. Primary Chilled Water Pumps
3. 2 Nos. Secondary Chilled Water Pumps
4. 1 Nos. Condenser Water Pumps

B. PIPING :

B.1 CHILLED WATER PIPING :

1. Complete Primary Chilled Water Piping in the Plant Room.
2. Complete Secondary Chilled Water Piping in the Plant Room.
3. Complete Condenser Water Piping in the Plant Room.

B.2 DRAIN PIPING :

1. Complete Drain Piping as per Drawing.
2. Complete Drain Piping as per Drawing for DX / VRF System.

B.3 PIPE COATING & INSULATION :

1. Entire Condenser Piping to be with FRP Coating.
2. Entire Chilled Water Piping to be with Nitrile Rubber Insulation.
3. Entire Condensate Drain Piping to be with Nitrile Rubber Insulation.

C. Drain piping with Insulation for entire Chilled Water System including Low side AHU's. **VALVES & ACCESSORIES :**

D.1 CHILLED WATER :

1. Motorized ON/OFF Butterfly Valves.
2. Butterfly Valves.
3. Ball Valve for Drain.
4. Energy Valves.
5. Manual Balancing Valves.
6. 2-way Modulating cum Automatic Balancing Flow Control Valves.
7. 2-way ON / OFF Valves.
8. Y-Strainers.
9. Suction Guide for Pumps.
10. Wafer Swing Check Valves.
11. Cartridge type side stream filter for closed loop.
12. Pressure Gauges.
13. Thermometer.
14. Automatic Air vents.

15. Flow Switch.
16. Sockets / Ball Valves for BMS sensors.
17. Flanges.
18. Accessories such as bends, elbows, tees, reducers, rubber gaskets, companion flanges etc.

D.2 CONDENSER WATER PIPING :

1. Butterfly Valves.
2. Motorized Butterfly Valves.
3. Suction Guide for pumps.
4. POT Strainers.
5. Ball Valve for Drain.
6. Wafer Swing Check Valves.
7. Sand Media type side stream filter for open loop system.
8. Pressure Gauges.
9. Thermometer.
10. Automatic Air vents.
11. Flow Switch.
12. Sockets / Ball Valves for BMS sensors.
13. Flanges.

D. FANS :

D.1 TOILET & PANTRY VENTILATION SYSTEM :

1. Toilet / Pantry Exhaust Fans for each Shaft.
2. PIR Ducting
3. Grilles
4. Diffusers
5. Dampers
6. Canvas Connections
7. Panels
8. Cabling
9. Earthing

E. COMMON AREA UPS ROOM AIR-CONDITIONING & VENTILATION SYSTEM.

F. DOCUMENTS REQUIRED (AS PER IGBC, CLIENT & PMC REQUIREMENT) :

F.1 Submission of Technical Data Sheets for all Materials / Equipment specified above.
F.2 Complete Final Design Basis Report
F.3 Equipment Selection & Calculation Sheets.
F.4 Technical Data Sheets for following :

1. Chillers for Conventional System
2. Primary Pumps for Conventional System
3. Secondary Pumps for Conventional System

4. Condenser Pumps for Conventional System
5. Motorized Valves for Conventional System
6. Toilet & Pantry Ventilation Fans F.5 Shop Drawings for entire HVAC Systems

F.6 Factory Testing :

1. 4 Point (100%, 75%, 50%, 25%) Testing report for 1 Chiller.
2. Consider 4 PAX from Client Side for Factory Testing Visit.

F.7 Factory Test Reports of all equipment/material

F.8 Site Testing & Commissioning Reports of entire HVAC equipment

F.9 Power Tap off to each AHU Room with Earthing.

F.10 Documentation required for Green Building Certification.

F.11 Handing over documents along with As-built drawings, Test Reports, List of spare parts, Escalation matrix, Operation Schedule & Maintenance Schedule.

SPECIFICATION OF EQUIPMENT / MATERIAL & INSTALLATION STANDARDS

1.0 WATER COOLED SCREW CHILLER

CHILLED WATER SYSTEM

The air-conditioning system shall be chilled water type in which water is cooled up to 7°C in the evaporator of refrigeration machine. This water is circulated to fan coil of the terminal units / AHUs with VFD located in the areas to be air-conditioned. The water at 7°C flows through the coil and air is blown from the coil, which means heat transfer takes place and will give ultimate effect in the area. The water temperature is increased to 12°C in the above action and the same is cooled again in the evaporator of the machine.

GENERAL

SYSTEM DESCRIPTION

Microprocessor-controlled water-cooled chiller utilizing a mono / twin rotor, 2960 rpm (50 HZ), direct drive, hermetic / semi-hermetic / open, multiple screw compressor using refrigerant 134A.

QUALITY ASSURANCE

Unit shall be rated in accordance with ARI / Eurovent standard. Unit construction shall comply with European directives- - Machinery directive 98/37/EC, modified.

- Low voltage directive 73/23/EEC, modified.
- Electromagnetic compatibility directive 89/336/EEC, modified, and the applicable recommendation of European standards-
- Machine safety-electrical equipment in machines, general regulations, EN 60204-1.
- Electromagnetic emission EN 50081-2.
- Electromagnetic immunity EN 50082-2.

Unit shall be designed, manufactured and tested in a facility with a quality assurance system certified ISO 9001.

Unit shall be manufactured in a facility with an environment management system certified ISO 14001. Unit shall be tested at the factory.

DELIVERY, STORAGE AND HANDLING-

Unit controls shall be capable of withstanding 55°C storage temperatures in the control compartment.

PRODUCTS & EQUIPMENT-

GENERAL-

Factory assembled, single-piece, air-cooled liquid chiller contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge (HFC – 134a), required prior to field start-up.

UNIT CABINET-

- Frame shall be made of U steel beam and protected by three layers of paint.
- The control box plates shall be steel with an oven-baked polyester-paint finish, and be capable of withstanding a 500-hour salt spray test in accordance with the ASTM B-117 standard (USA).

COMPRESSORS-

- Unit shall have semi-hermetic mono / twin-screw, gear-driven compressors with internal muffler and check valve.
- Each compressor shall be equipped with a discharge shut-off valve.
- Capacity control shall be provided by pilot-operated solenoid valve, capable of reducing unit capacity to 20% of full load. Compressor shall start in unloaded condition.
- Motor cooling shall be provided by direct liquid injection and protected by internal overload thermistor.

 Signature & Seal of Contractor

- Lube oil system shall include pre-filter and internal filter capable of filtration to 3 microns.

EVAPORATOR-

Unit shall be equipped with a single evaporator.

- Evaporator shall be tested and stamped in accordance with applicable European pressure code for a refrigerant side operating pressure of 1700 kPa (service des Mines units) and for a maximum water-side pressure of 1000 kPa.
- Shall be mechanically cleanable shell-and-tube type with removable heads.
- Tubes shall be internally-enhanced, seamless-copper type, and shall be rolled into tube sheets.
- Shall be equipped with Victaulic water connections (accessory flanges on request).
- Shell shall be insulated with 19 mm closed-cell, polyvinyl-chloride foam with a maximum K factor of 0.28.
- Shall incorporate two independent refrigerant circuits.
- Shall have an evaporator drain and vent.
- Shall incorporate a refrigerant level control system.

CONDENSER-

- Coil shall be Water-cooled with integral sub cooler and shall be constructed of aluminium fins mechanically bonded to internally finned copper tubes. The tubes are then cleaned, dehydrated and sealed.
- Condenser tubes shall be leak tested and shall be pressure tested at 3400 kPa.

REFRIGERATION CIRCUITS-

Refrigeration circuit components shall include oil separators, high and low side pressure relief devices (according to applicable standards), discharge and liquid line shutoff valves, filter driers, moisture indicating sight glasses, electronic expansion devices, refrigerant economizers and complete operating charges of both refrigerant and compressor oil.

CONTROLS, SAFETIES AND DIAGNOSTICS-

1. CONTROLS-

a. Unit controls shall include as a minimum; the microprocessor board, and a 6-digit diagnostic display with keypad.

b. Shall be capable of performing the following functions -

- Automatic changeover between compressors.
- Capacity control based on leaving chilled fluid temperature with return fluid temperature sensing.
- Limiting the chilled fluid temperature pull-down rate at start-up an adjustable range of
  0.1°C to 1.1°C per minute to prevent excessive demand spikes at start-up.
- Enable adjustment of leaving chilled water temperature according to the return water temperature or by means of a 0 – 10 V signal to the outdoor temperature.
- Provide a dual set point for the leaving chilled water temperature activated by a remote contact closure signal.

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- Enable a 2-level demand limit control (between 0 and 100%), activated by a remote contact closure signal.
- Control water pump(s) operation.
- Enable automatic lead-lag of two chillers in a single system.

2. DIAGNOSTICS-

a. Display module shall be capable of displaying set points, system status (including temperatures, pressures, run time and percent loading), and any alarm or alert conditions.

b. Control Module, in conjunction with the microprocessor, shall be capable of displaying the output of a full load run test to verify operation of every switch, sensor, fan and compressor before the chiller is started, and carrying out a diagnosis and preventive maintenance (incorrect water loop, oil filter dirty etc.)

3. SAFETIES-

a. Unit shall be equipped with all necessary components and in conjunction with the control system shall provide the unit with protection against the following - Loss of refrigerant charge.
- Reverse rotation.
- Low chilled water temperature.
- Low oil pressure (per compressor).
- Current imbalance.
- Thermal overload.
- High pressure.
- Electrical overload. - Loss of phase.

b. Fan motors shall be individually protected by a circuit breaker.
Control shall provide general alarm remote indication for each refrigerant circuit. Control system shall have a RS485 serial output port (option and accessory).

OPERATING CHARACTERISTICS-

- Unit shall be capable of starting and running at full load at outdoor ambient temperatures from 0°C to 46°C.
- Unit shall be capable of starting up with 25°C entering fluid temperature to the evaporator.
-

ELECTRICAL CHARACTERISTICS-

- Unit electrical power supply shall enter the unit at one or two locations.
- Unit shall operate on 3-phase power supply without neutral.
- Unit with two compressors shall have a factory-installed, star-delta starter to limit electrical inrush current.
- Control voltage shall be supplied by a factory-installed transformer.
- Unit shall be supplied with factory-installed electrical disconnect switch / circuit breaker.

FINISHING-

Electrical cabinet colour – as per manufacturer. Compressor / heat exchanger colour – as per manufacturer

LOW-VOLTAGE UNIT MOUNTED STARTER

A reducer voltage wye-delta or double / solid-state starter shall be supplied. The compressor motor starter shall be factory mounted, wired, and tested prior to shipment by the chiller manufacturer. Customer electrical connection for compressor motor power shall be limited to main starter power connection only. Solid-state starter shall provide stepless compressor motor accelerating and limit motor in rush current to 150-300% of compressor motor RLA. The starter shall include 6 Silicon Control Rectifiers (SCR) with integrally mounted bypass contactors to provide SCR by pass once the motor has achieved full voltage and speed. The starter shall also include automatic acceleration kick circuitry which monitors motor current subsides and automatically ramps voltage up at a faster rate to eliminate the instability that occurs at the break away torque point.

Starter shall be UL and CSA approved and shall include-

- NEMA 1 enclosure with integral fan cooling and lockable hinged doors.
- Main power disconnects (non-fused type)
- Solid-state 3-phase over load relay with manual reset. 2 KVA control / oil heater transformer
- Branch circuit breaker for control power and oil heater 5 pilot relays for control of chilled water pump.
- Condenser water pump, tower fan, customer remote alarm, shunt trip, and main power disconnect. The shunt trip shall be energized by the SMM during unauthorized operation (such as loss of communication) between the SSM (Starter Management Module) and PSIO (Processor Sensor Input / Output Module).

Solid-state starters also include the following standard features-

- Current imbalance detector which monitors 3 phase motor current to provide the following protection-
- Phase loss
- Phase reversal
- Phase imbalance
- Ground fault
- Shorted SCR
- Current flow while stopped protection

 Diagnostic LED's shall be provided to indicate:

- Starter on
- Run (up to voltage)
- Phase corrects
- Over temperature fault
- SCR gates energized
- Ground fault
- Current imbalance fault -
- Shorted SCR.

I^2T fuses the solid-state circuitry at 200,000 amp interrupting capacity.

ELECTRICAL REQUIREMENTS

The contractor shall supply and install main electrical power line, disconnect switches, circuit breakers, electrical protection devices per local code requirements and as indicated necessary by the chiller manufacturer. The contractor shall wire the water flow switches to the chiller control circuit to ensure that chiller will not operate until flows are established & maintained as per contractors / consultant's specifications. The contractor shall supply and install electrical wiring and devices required to interface the chiller controls.

PIPING REQUIREMENTS – INSTRUMENTATION AND SAFETIES

The contractor shall supply and install pressure gages in readily accessible locations in piping adjacent to the chiller such that they can be easily read from a standing position on the floor. Gages shall be very accurate. Scale range shall be such that design valves shall be indicated at approximately mid-scale. Gauges shall be installed in the entering and leaving water lines of the cooler and condenser. HVAC contractor shall supply & install flow detection devices in chilled water and condenser water piping. Switches shall make contact when flow is established. Flow switches shall be installed in horizontal runs at least 5 pipe diameters down-stream from any bend or tee.

INSULATION

1. Chilled water piping and cooler water boxes shall be installed by the HVAC contractor.
2. Chiller shall be insulated at factory. Final layer of insulation shall be installed at the job site by the HVAC contractor along with cladding.
3. Chiller insulation shall confirm to UL standard 94, classification 94 HBF and should be suitable for positive temperature operation.

VIBRATION ISOLATION

Chiller manufacturer shall furnish neoprene isolator pads for mounting equipment on a level concrete surface.

START-UP

1. The manufacturer shall provide a factory trained representative, employed by the chiller manufacturer, to perform the start-up, operation and maintenance manual provided by the chiller manufacturer.
2. After the above services have been performed, the same factory trained, representative shall be available for a period of class room instruction (not to exceed 4 hours) to instruct the chiller owner's personnel in the proper operation and maintenance of the chiller.
3. Manufacturer shall supply the following literature-
   a. Start-up, operation and Maintenance Instructions.
   b. Installation Instructions
   c. Field Wiring Diagrams
   d. Maintenance manual showing maintenance based on calendar basis and hourly basis.

QUALITY ASSURANCE

i. Chiller performance shall be rated in accordance with AHRI Standard 550/590, latest edition.

ii. Equipment and installation shall be in compliance with ANSI/ASHRAE 15 (latest edition).

iii. Cooler and condenser shall be in compliance with ASME OR equivalent code for unfired pressure vessels.

iv. Centrifugal compressor impellers shall be dynamically balanced and over-speed tested by the manufacturer at a minimum of 120% design operating speed.

Each compressor assembly shall undergo a mechanical run-in test to verify vibration levels, oil pressures, and temperatures are within acceptable limits. Each compressor assembly shall be proof tested at a minimum 204 psig (1406 kPa) and leak tested at 185 psig (1276 kPa) with a tracer gas mixture.

v. Entire chiller assembly shall be proof tested at 204 psig (1406 kPa) and leak tested at 185 psig (1276 kPa) with a tracer gas mixture on the refrigerant side. The water side of each heat exchanger shall be hydrostatically tested at 1.5 times maximum working pressure.

vi. Prior to shipment, the chiller automated controls test shall be executed to check for proper wiring and ensure correct controls operation.

vii. 4-point Factory testing for ONE Chiller of each type 5 PAX from client's side.

A) CAPACITY & EFFICIENCY:

One Chiller shall be tested for performance at Manufacturer works at 100% & 25% at AHRI condition and at 75% and 50% at Design condition (at constant condenser entering temperature) for verification of IKW/TR & Capacity as per submission of AHRI selection data sheet. If the inspection is outside India, the contractor shall visit and witness the test and shall submit photographs/proof to ascertain his witnessing the testing. The Client (MCGM / consultant) representative may also witness the test. The cost of their visit shall be borne by the Client. However, necessary coordination shall be arranged by the Contractor for their visit. In case of failure of any equipment during testing, the Contractor shall be bound to arrange for subsequent inspections. All the expenses (including travel, boarding etc.) for such inspections shall be borne entirely by the Contractor.

1) Casing: The casing should be of GRP.

2) Access: 1 no. Portable Aluminium Ladder per Cooling Tower shall be supplied.

3) Civil Work, Electrical Work, Piping, Pumps, etc.: All excluded from Vendors' scope.

Enclosed herewith is the water quality chart.

2.0 PUMPS

A. Pumps shall be of Horizontal split-case type and suitable for the given duty points and parallel operation -

i.	Type	-	Inline / End Suction
ii.	Impeller	-	Bronze confirming to BS - 1400
iii.	Shaft	-	High Tensile Steel
iv.	Bearings	-	Ball/Roller
v.	Pump/Motor Body	-	CI confirming to IS -210
vi.	Seal	-	Mechanical
vii.	Motor	-	Sq. cage T.E.F.C.
viii.	Starter	-	Star Delta

ix. Shaft Sleeve - Bronze LG2

Pumps shall be selected for the rated conditions indicated. Efficiency of the pump proposed to be used shall be high. Peak efficiency shall be obtained at or near rated conditions. Impellers shall be statically and dynamically balanced.

B. Motor rating shown are only tentative and tenderer shall select their drives atlas 5% in excess of the max. BHP of the pumps. Motor shall be TEFC weatherproof design in IP-55 enclosure IE-3 rating, Class-F Insulation

The following accessories shall be provided where required with each pump besides other standard accessories -

i. Lubrication fittings and seal packing.
ii. Test and air vent cock.
iii. Drain Cock.
iv. Adequately sealed Terminal box for Aluminium conductor armored cable termination.

C. The following fittings shall be provided with each pump besides other standard fittings (to be measured and paid for separately) -

i. Suction and discharge shut-off valve, discharge check valve as specified under respective items.
ii. Suction and discharge pressure gauge not less than 150 mm diameter & of the appropriate rating with gauge cocks etc.
iii. 25mm GI drain piping up-to the nearest drain point.

D. The pump casing should be of closed grain with smooth finishing ensuring minimum frictional losses and having sufficient strength to withstand the forces due to water flow at all working conditions.

E. The impeller should be of Bronze and statically and dynamically balanced to ensure smooth working without vibration and noise.

F. Pumps shall be installed as per the manufacturer's recommendation. Pump shall be mounted on floating foundations, which in turn are mounted on vibration isolators. The Contractor shall supply the floating frame and vibration isolators & concrete foundation.

G. After complete installation, original paint of the pump shall be retouched and accessories, fittings and floating foundations frame shall be given two coats of synthetic enamel paints of color specified in specifications for paining Works / Approved color over a coat of primer.

2.1.1 TESTS & INSPECTION

A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the maximum discharge head or twice the rated discharge head., whichever is higher. While arriving at the above pressure, the maximum suction head shall be taken into account. The hydrostatic tests on the casing shall be conducted for a minimum duration of 30 minutes.

2.1.2 PERFORMANCE TEST

(a) Standard Running Test

The pumps shall be tested as per IS 5120, at rated speed at SUB-CONTRACTOR's works to measure capacity, total head, efficiency and power. The negative tolerance on efficiency shall be limited to 2.5% (not 5 % as indicated in IS 5120. These tests shall form the basis for acceptance of pumps except for vibration and noise. The pumps shall be tested over the range covering from shut-off head to the maximum flow. The duration of the test shall be minimum one hour. Minimum five readings approximately equidistant shall be taken for plotting the performance curves.

(b) NPSH TESTS

NPSH tests shall be conducted with water as the medium.

2.1.3 MECHANICAL BALANCING

In addition to static balancing, impeller and balancing drum shall be balanced dynamically at or near the operating speed.

2.1.4 FIELD TESTING

After installation, the pumps shall be subjected to testing at site also. If the field performance is found not to meet the requirements regarding vibration and noise as specified, the equipment shall be rectified or replaced by the CONTRACTOR, at no extra cost to the EMPLOYER.

2.1. CONDENSER PUMPS

2.2.1 GENERAL

The variable pumping system should allow for the operation of multiple pumps of the same size in parallel at the same output frequency. It shall stage the pumps on and off as required to meet the system demand to provide increased performance, precision control and maximum energy savings. The pump controller software package should determine the settings for the controller to help in optimizing the control system by predicting the best staging on and off frequencies.

2.2.2 CONFIGURATION

The pump controller shall form an integral part of the VFD itself and shall not be supplied as a standalone basis.

It shall have a 4-line alphanumeric display which is capable of displaying all the operating parameters. It shall be possible to program the VFD and the pump controller through the same local display panel. It shall be possible to supply the VFD and pump controller in IP 20 and IP 54 protection. Display key pad should be detachable and can be mounted on the panel door (up to 3 meter distance) The pump controller shall be capable of running up to five equally sized pumps in parallel in the best efficiency pattern. The VFD-cum-pump controller shall be suitable for adapting itself to any locally available standard sized pumps and shall be capable of maintaining its best efficiency operating pattern throughout its operating speed. No de-rating of the pump motor shall be applicable to the offered VFDS.

2.2.3 AUTO / OFF/ MANUAL CONTROL

It shall be possible to set the Auto / Manual control for the pumps from the control panel of the VFD. During normal operation on the VFD shall be in the AUTO mode and the pump controller should start and stop the pumps as necessary.

The HAND position should allow for the manual start of each pump as necessary e.g. at manual operation, commissioning etc. It shall be possible to permanently disable a pump by setting the switch to OFF. If a pump is disabled for service, the pump controller shall enable the next pump to be switched ON to meet the system demand.

2.2.4 OPERATING MODE

The VPS shall follow a master / slave systems set up, where all pumps and are speed controlled with Variable Frequency Drives. The pumps shall be of the equal size and should be run at the same speed. One of the VFD shall act as a master and the other VFDS shall act as slaves which follow the speed of the master pump. It shall be possible to stage ON and OFF the slave pumps as necessary by the master to match the system requirement.

The in-built pump controller shall calculate the best efficiency operation which optimizes the number of pumps to achieve the highest system efficiency based on the number of pumps operating in parallel, the system design head and set point head and the pump curves.

2.2.5 STAGING / DESTAGING DELAY

It shall be possible to program a staging and de-staging delay time to prevent fast cycling of the salve pumps.

2.2.6 PUMP CYCLING

In order to achieve equal operation of the slave pumps, the pumps should be cycled. Whenever a pump has to be started, the pump with the least hours is switched on. In case pump has to be switched off, the pump with the most hours is switched off.

STAGING FREQUENCIES

It shall be possible to program the staging ON / OFF frequencies in the display panel of the VFD which will determine the frequencies at which the slave pumps should be switched ON & OFF to maintain the best efficiency operation.

2.2.7 DRY RUNNING PROTECTION

The pump controller shall have a provision to wire a flow switch to the interlock terminals to avoid dry running of the pumps.

2.2.8 PID CONTROLLER

The system shall be controlled through a fully programmable PID controller which has the capability to accept the set points in process units (e.g. GPM or m3/h). The PID controller shall have the provision to accept two remote feedback signals from differential pressure transmitters, giving an output of 4-20 mA, located in the chilled water pipe line from the field.

It shall be possible to select the most deviated signal as feedback for controlling the speed of each pump. Each input signal shall be capable of accepting a different set point. The controller shall be capable of controlling up to 5 pumps in parallel in the

master / salve control mode. It shall be possible to program the proportional, integral and derivative value inputs to the controller for fine tuning of the PID controller.

2.2.9 DISPLAY

The pump controller VFD shall have a 4-line, back lit, alpha numeric display capable of displaying all messages in English in text form. It shall have a quick programming menu for faster commissioning and a detailed menu for fine tuning of the system parameters.

The display panel shall have LED pilot lights for RUN, TRIP and WARNING conditions. The key pad switches shall be of soft touch type.

The following parameters shall be displayed on the display panel-

RPM of the pumps
Differential pressure in kg/cm^2
Motor Current in Amperes
Motor voltage in Volts
Energy consumed by individual pump in kWh
Run time of each pump in hours
No of pumps working (on the master drive)
KW consumed by the pump in kW

DATA SHEET – A

TECHNICAL REQUIREMENTS

1	**DESIGN FEATURES**		
1.1	Pump designation		
1.2	Minimum design capacity	LPS	
1.3	Total head	M	
1.4	Location		
1.5	Maximum rated speed (at 50 Hz.)	RPM	
1.6	Liquid handled		
1.7	Number required		
2.0	FEATURES OF CONSTRUCTION		
2.1	Type of pump		
2.2	Impeller		
2.3	Volute		
2.4	Shaft		
2.5	Drive Transmission		
2.6	Seal		
2.7	Coupling		
2.9	Prime Mover		
3.0	**MATERIALS OF CONSTRUCTION**		
3.1	Impeller		
3.2	Casing		
3.3	Shaft		
3.4	Shaft Sleeve		
3.5	Impeller Ring		
3.6	Casing Ring		
3.7	Stuffing Box Packing		
3.8	Base Plate		
	Note: For components marked * material test certificates shall be furnished		
4.0	**ACCESSORIES**		
4.1	Companion Flanges		
4.2	Foundation Bolts		
4.3	Base Plate		
4.4	Flexible connections at inlet / outlet		
5.0	**TESTING**		

5.1	Hydrostatic Test Casing Jackets / Cooling Passage		
5.2	Performance Test Std. Running Test NPSH Test		

DATA SHEET - B

DATA TO BE FURNISHED BY TENDERER ALONG WITH OFFER

Sr.	DESCRIPTION	TENDERER TO FURNISH
1	Pump tag number	
2	Number working stand by	
3	Make	
4	Model	
5	Design Capacity	LPS
6	Differential Head	MLC
7	Shut off head	MLC
8	Hydrostatic test pressure	Kg / cm^2(g)
9	Pump efficiency	%
10	Motor efficiency at duty point	%
11	Power input to motor at duty point	KW
11.1	Motor rating –BKW / KW	KW
12	Rated speed	Rpm
13	NPSH required	MLC
14	Materials of construction as per specification indicate deviations	
15	Suction Nozzle	
15.1	Orientation	
15.2	Size	Mm
16	Discharge Nozzle	
17	Impeller type	
18	Pump weight	Kg
19	Pump set weight	Kg
20	Moment of inertia of pump rotor	Kg – m^2

 Signature & Seal of Contractor

DATA SHEET - C

DATA TO BE FURNISHED BY THE CONTRACTOR AFTER AWARD OF CONTRACT

AND `BEFORE' INSTALLATION

1. Quality Assurance Plan (QAP)
2. Detailed dimensioned general arrangement drawing of pump and driver.
3. Foundation drawing of pump and driver with static and dynamic loads, details of fixing, grouting and all relevant data required for design of foundation.
4. Cross-section drawing of the pump with complete part list, materials of construction and relevant standards for each part.
5. Pump performance curves flow rate Vs head, BKW, efficiency, NPSHR from zero flow to maximum flow and torque-speed curve.
6. Scheme for pump sealing, lubrication and cooling.
7. Driver dimensional drawing.
8. Surface preparation and painting procedures.
9. Catalogues, data sheets and drawings for instruments.
10. Installation, operation and maintenance manual.
11. Isolation pads and SS or Hot dip galvanized foundation bolts provided by the Contractor.
12. Cori-rubber make metallic bellows shall be provided at suction and discharge.
13. Pressure gauges with needle valve provided at suction and discharge lines.
14. All accessories provided to complete the pump installation.

DATA SHEET - D

CHECKLIST AND PERFORMANCE TEST DATA TO BE PROVIDED AFTER INSTALLATION

N	Description	Unit	Time			Date			Remarks
			10.00	12.00	14.00	16.00	18.00	20.00	
1.	Suction pressure	Kg/cm^2							

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2.	Discharge pressure	Kg/cm^2							
3.	Water flow rate	LPS							
4.	Current	Amps							
5.	Bed plate levels and alignment checks								
6.	Hydraulic test for casing at 1.5 times design pressure								
7.	Noise level from pump	1.8m dB							
8.	Discharge Vs head	Mtr							
9.	Discharge Vs efficiency								
10.	Discharge Vs BkW								

MODE OF MEASUREMENT:

1.0 Representatives from the Contractor and Engineer shall conduct a joint inspection of the Equipment's. All the discrepancies observed either incomplete works or defective work shall be clearly indicated in the joint inspection report. The mode of measurements given below is for the purpose of measurement and payment and the scope of works shall be as specified elsewhere in the specification.

2.0 CENTRIFUGAL PUMPS

Each pump set including motors, flexible connection at inlet and outlet, vibration isolators and accessories as specified in tender document shall be regarded as one unit for the purpose of measurement and payment.

3.0 VARIABLE FREQUENCY DRIVES

3.1. VFD FOR AHU'S

1) The VFD shall be of the type suitable for operation on a 3 phase, 415 V, 50 Hz input power supply at the following conditions:

Input supply voltage variations : ± 10 % Input
supply frequency variations : 48 – 52 Hz ± 1%
Ambient temperature : 0 - 45° C, without derating.
Maximum relative humidity : 95% non-condensing
Vibration : 0.7 G RMS in 3 directions
Minimum efficiency at full load : **97%**

2) The VFD's will be mounted in the open near the AHU's / Pumps in the AHU / Plant room. Hence the VFD's shall have integrated; factory built metallic enclosures of IP 55 rating, without any de-rating. VFD's of IP 00 / IP 20 / IP 21 / IP 42 rating enclosures with additional sheet metal enclosures to achieve IP 55 ratings are not permitted.

3) VFD's shall conform to the recognized international standards like IEC and manufactured according to ISO 9001, BS 5750 part 1 & 2 and shall be UL listed. It shall carry the CE mark on EMC compliance.

4) The VFD shall be capable of providing a starting torque of 160% for 0.5 sec and an overload torque of 110% torque for 1 minute.

5) The VFD shall maintain full output voltage during main's variations of ±10% to prevent loss of torque and speed variations occurring during motor operation.

6) The VFD shall comply with Electro Magnetic Compatibility (EMC) document **IEC/EN 61800 -3** for Radio Frequency Interference (RFI) control (emission) as an integral part of its design by incorporating RFI filters to meet **C1 -50 Mts, Unrestricted distribution for conducted emission.**

7) For AHU application, VFD should be able to give "Clog Filter" (by potential free contact) indication as per the set pressure requirement.

8) If a temperature / pressure / flow feedback signal is given to the VFD, it shall use its PID controller to modulate the speed in such a way that the set point of temperature or pressure is accurately maintained. This should eliminate the requirement of PID loop of BMS or external PID controller.

9) Additional PIDs (3 Nos.) are required to control chilled water valves and fresh air damper. This should be an integral part of the VFD.

10) The VFD shall be capable of accepting three such feedback signals simultaneously and be able to do a speed control based on average / sum / difference / minimum / maximum / 3 zone control of the above 2 signals. This should work in absence of BMS or should not use PID loop of BMS, in case of presence of BMS.

11) The PID controller shall be capable of programming the set points and incoming signals in any of the flowing units: RPM, l/s, l/m, l/h, m3/h, m3/s, bar, Pa, kPa, GPM, lb/s, lb/h, CFM, in3/h, in wg, ft wg, PSI, kW, HP, ºC, ºF, as required by the application, and be able to display the same while in operation. This should eliminate the requirement of PID loop of BMS or external PID controller.

12) In case the VFD detects a broken belt (AHU etc.) or coupling (pumps etc.), it shall display a warning signal to that effect. There shall be provision to export this warning signal to the BMS system through RS 485, without any need of I/Os of BMS.

13) For easier maintenance and to reduce inventory, the VFD shall allow connection of motors one frame size larger and 4 sizes smaller than its nominal rating.

14) The VFD shall have the following protective functions: Electronic motor overload, Protection to motor and VFD against input transients, phase loss, short circuit, under voltage, over voltage, phase imbalance, motor over temp., phase to phase short circuit or earth fault at motor terminals.

15) The VFD's shall have internal harmonic filters on the DC bus **(on both positive & negative limbs)** to reduce THVD to below 5% as per IEEE standard 519-1992. AC line chokes on the input side are not allowed for harmonic current control as it will cause voltage drop to the VFD and motor.

16) The Upeak of the VFD shall be below 1000 Volts (when measured with a cable length of 50 meters) to prevent damage to motor insulation.

17) Manufacturer of the VFD shall submit data sheet to verify this requirement in order to permit the usage of standard motors for the applications specified.

18) The VFD shall be capable of having an output motor cable length of at least 150 meters (armored cabling) without any need of additional equipment like output chokes.

This is essential for applications like chilled water pumps where the motors are located far away from the control center.

19) The VFD's shall incorporate a surge protection circuit as standard to protect the VFD from transients and spikes in the incoming power supply.

20) The VFD shall be fully protected from switching a contactor / isolator at the output without causing tripping e.g.: for switching on/off the isolators of the AHU / ventilation fans / pumps near the motor and switching back ON with VFD in on mode.

21) The display of the VFD shall be Alpha numeric **(Graphical)** type.

LED displays are not acceptable, as it is not user friendly. Display of all messages and faults shall be in English text format. Codes are not acceptable. The display shall show the following operating parameters:

- Energy consumed in kWh
- Power consumed by motor in kW Run time of motor in Hours Current drawn by motor in Amps.
- Output frequency in Hz.
- Motor speed in RPM
- Set point in process units
- Feedback in process units

22) It shall be possible to see at least 4 of the above operating parameters in the VFD display, simultaneously.

23) The VFD's shall have internal galvanic isolation (PELV) to avoid damage to BMS / PLC / DDC system when interconnected. If PELV is not available, the VFD vendor should offer optoisolators for all the inputs and outputs in the VFD.

24) The VFD shall automatically operate at high switching frequency at low speeds and low switching frequency at high speeds to maintain silent operation of the AHU's at all speeds. The switching frequency range shall be from 4-14 kHz for VFD's to be installed on AHU's.

25) The VFD shall optimize the magnetizing current on a real time basis based on actual torque requirement (energy optimization function) to minimize the power consumption compared to standard variable torque VFD's. VFD's offering fixed settings of V/f ratios are not permitted.

26) The VFD shall have Auto / OFF / Manual switch on the key pad itself. It shall be possible to manually change the speed of the AHU's from the key pad of the VFD, if required, without the need of an external potentiometer. In manual mode the speed reference signal shall be from keypad of VFD and in auto mode, the reference shall be from the remote – either BMS or transmitter.

27) The VFD shall have self adjustable ramp times to prevent tripping / VFD damage in case in appropriate ramp times is set with respect to application requirement.

28) The VFD's shall have the provision to program a minimum and maximum speed of operations, through the VFD programming itself.

29) In case of a power failure, the VFD shall be capable of automatically restarting after a programmable time delay, without need of an operator having switch on unit.

30) To prevent damage to the VFD's due to pre-rotating fans, the VFD shall have the capability to detect such spinning fans and adjust its frequency to its spinning speed before it starts controlling the fan. If the fan is running in the opposite direction, the VFD should brake the fan by sending a DC current, before starting the fan in the right direction.

31) If the transmitter feedback signal goes below a particular low limit value or goes above a particular high limit value, the VFD shall give an alarm signal. It shall be possible to transfer this signal to the BMS system as well.

32) The VFD shall be provided with at least 4 by-pass frequencies with adjustable band width in order

to eliminate resonance in duct work and pipe lines occurring within the motor's operating frequency range.

33) The VFD shall have an auto de-rating facility by operating at a lower capacity in case of a phase loss or higher ambient temperature so that minimum air conditioning can be maintained. VFD's that trip on a phase loss or high ambient temperatures are not suitable for this application and hence not permitted.

34) The VFD's shall have the provision of 4 parameter set ups, which can be activated by the BMS or by digital inputs.

35) The variable frequency drives (VFD) shall have the provision to integrate into a BMS system, utilizing a serial communication protocol – open protocol or BMS specific protocol - that enables a full "read & write" seamless interface between VFD & BMS. The VFD manufacturer shall be responsible for technical support to the BMS Vendor in the implementation of a serial interface to the BMS System. The BMS Vendor shall be responsible for the complete "integration and interoperability" of the VFD through the BMS via the serial interface.

36) The VFD shall provide to BMS, via serial communication (by RS-485, 2 wire), access to the following VFD parameters as a minimum:

- Motor current
- Motor kW
- AHU KWh
- AHU Running hours
- Auto / Off / Manual status feedback
- PID controller programming
- Set point programming
- Alarms
- Run & Trip status
- Air flow status / alarm
- Dirty filter status / alarm
- Fault log history

37) The VFD shall also be able to provide the following selectable & programmable physical I/Os to the BMS system

- 6 Digital inputs (for start, stop, interlock, auto, manual, setup selection etc).
- 2 Relay outputs (for reading Auto / Manual status & VFD On / Off indication)
- 2 Analog input, 4 – 20 mA (for single feedback signal to VFD)

- 3 Analog inputs 0-10V (for feedbacks, if two feedbacks are taken) 1 Analog Outputs, 4-20 mA (for speed & kW feedback to BMS)
- 2 Analog Outputs, 0-10V for any other feedback required.

38) VFD shall have inbuilt real time clock for scheduling purpose.

39) If the VFD loses the feedback signal or reference signal in auto mode, the VFD shall be capable of maintaining the speed at which it is running.

40) If the VFD operates at the minimum speed for a set time, it shall be able to program the VFD to automatically switch off to save power.

A parameter lock shall be available in the VFD local display panel to prevent unauthorized resetting of parameters.

4.0 AIR-CONDITIONING UNIT/S

4.1 DOUBLE SKIN INTEGRATED AIR HANDLING UNIT/S

4.1.1 SCOPE

The scope of this section, comprises the supply, erection, testing and commissioning of double skin construction air handling units, conforming to these Specifications and in accordance with requirements of drawings and of the Schedule of Quantities

4.1.2 TYPE

The air handling units shall be floor mounted type with horizontal / vertical airflow arrangement with cabinet casing of double skin construction consisting of aluminium profile structure and insulated sandwich panels, draw-thru or blow through type comprising of various sections like –single or double stage filter section, coil and hydraulics section , starter panel and controller section, Direct drive EC fan section etc. as shown in the schematic layout arrangement drawings and included in schedule of quantities. Customized sections to include components like Hot water coil, mixing box, adiabatic pads, heat recovery wheels, automatic damper modules, heater and humidifiers etc. must be possible to integrate in modules as per requirements.

4.1.3 CAPACITY

The air handling capacities, maximum motor horse power and static pressure shall be as shown on Drawings and in Schedule of Quantities. The AHU design must be based on airflow velocities, pressure drops and static requirements as specified.

4.1.4 UNIT HOUSING / CASING

The unit casing shall be made of double skin design comprising of the chassis structure made of extruded aluminum framework with thermal / non thermal break profile of 48mm / 25mm as specified in Bill of Quantities. The panels shall be double skin sandwich type with minimum 1.0 mm thick powder coated/pre coated steel sheet on the outer side and minimum 0.8 mm thick galvanized sheet on inner side with 45mm ± 2 / 25± 1 mm thick rockwool insulation material of density 60 kg/cum between both inner and outer skin. Considering fire safety norms injected PU foam insulation is not acceptable.

The base frame of the AHU shall be made of 100mm high steel profile structure for rigidity.

All sections/panels shall be bolted to each other with Neoprene rubber gasket in between and fixed with steel screws for perfectly aligned and airtight joints. The gaskets shall be held in place by inserting them in the integrated channels in the framework. All panels shall be detachable or hinged. Hinges shall be made of die cast aluminum with stainless steel pivots. Door handles and locks shall be made of self-extinguishing thermoplastic nylon filled with glass wool and minerals. Marine lights can be provided in fan & coil sections, if required, to see the inside and shall be interlocked with door opening.

Condensate drain pan shall be provided with multiple slopes towards drain outlet. Condensate drain pan shall be fabricated from SS 304/GI powder coated, insulated with 19 mm thick closed cell elastomeric insulation.

4.1.5 EC - FAN SECTION (ELECTRONICALLY COMMUTATED)

Unit must be provided with direct drive backward curved EC fans each running with DC drive electronically communicated motors, the fans should be aligned and balance statically and dynamically. The fan speed must be controlled based on the room return air temperatures and also must have automatic step-less speed control without manual intervention.

The fans can be in multiple numbers as per the manufacturer's standard. Units shall be factory balanced. Fan curves must be provided to confirm selection as and when required. The motor and fan must be from approved manufacturers as one assembly.

Noise Level: Less than 73 db from 2 Mtr. of unit in free filed conditions.

Only direct drive fans to be provided in offered units and centrifugal fans with belt drive is strictly not acceptable.

4.1.6 COOLING COIL / EVAPORATOR COIL SECTION

The cooling section shall be of Chilled Water Coil, DX Coil, Dual Fluid or Dual Chilled Water as specified in the Bill of Quantities.

Coil shall be shall be made from seamless copper tubes with aluminum anti-corrosive corrugated fins/Hydrophilic coated blue fins. The tubes shall be solid drawn copper of not less than 9.5 or 12.5 mm dia. and minimum 0.4 mm wall thickness.

Aluminum fins shall be continuous and equally spaced by collars forming integral part of the fins. The number of fins shall not be more than 12 FPI and the thickness of fins shall be minimum 0.11mm. The fins shall be uniformly bonded to copper tubes by mechanical/hydraulic expansion for minimum thermal contact resistance with fins. The fins shall be assembled in a GI or specified in BOQ. Coils shall be sliding track mounted inside the Unit for easy replacement. Each section of the coil shall be fitted with supply & return header of Copper/MS to feed all passes of coil equally. U bends shall be of forged copper and shall be joined to tubes by brazing and silver soldering.

Headers shall be provided with flanged ends for pipe connections. The headers shall also be provided with vent plug at top and drain plug/valve at bottom. The coil shall be designed for a maximum working pressure of 7 Kg/Sq.cm. Each coil shall be factory-tested at 21 kg/sq.cm air pressure under water. Computerized cooling coil selection output shall be submitted.

Coil selections must ensure total water side pressure drop including header are not exceeding 50 kPa as per design standards.

4.1.7 CHILLED WATER CONTROL VALVE

The coil and hydraulic section of the air handling unit shall be provided with factory fitted required size of 2 Way Valve/Pressure Independent Dynamic Balancing Valves with actuators to stabilize the flow and to have better heat transfer resulting in Energy savings and increase in overall performance of the unit. The type of valve to be used shall be in accordance with specification in bill of quantities. Manufacturer to ensure the valve control is possible via integrated control signal based on feedback from temperature sensors of return or supply air as control logic specified.

4.1.8 PRE-FILTER SECTION

Each unit shall be provided with a factory assembled filter section containing synthetic media washable air filters with efficiency of 90% down to 10-micron particle size confirming to MERV 8. Filters shall have aluminum frame. Filter face velocity shall not exceed 500 FPM. Holding frames shall be provided for installing

number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels. Optionally high efficiency filters wherever required can be provided as separate sections.

4.1.9 ELECTRICAL PANEL

The air handling unit shall have inbuilt integrated electrical starter panel with AUTO/Manual over ride switch for operation. Control cabinet to be provided with Type 2 enclosure, with grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control circuit transformer. The electric panel provided for the unit must be equipped with main incoming power isolation switch, additionally the unit must be provided with under voltage / over voltage / phase reversal / single phasing protection in standard for DX systems, all three phase motors must be operated only via. 24V / 48V coil voltage contactors and MPCB's, additionally step down transformer must be provided for power supply to the unit controller. The electrical panel must also be providing with relay block for common alarm.

4.1.10 MICRO PROCESSOR CONTROLLER

The controller to be equipped with appropriate capacity processor with minimum 128 MB Flash + 128 MB DDR3 Memory. The controller should have ports for BMS Connectivity using Modbus RTU protocol. The power input to the controller shall be DC 24, with working range of DC 9V-28V, the power consumption should be less than 10W. Touch Screen Display shall be provided as standard and the controller / DDC must be compatible to connect to a laptop or display for configuring or viewing unit performance parameters.

The controller to have the following outputs:

- Temperature (Air, Water) connectivity as per devices options.
- Sensor Using Rs485 (Modbus slave) connectivity.
- CO2/VOC sensor connectivity – optional, if mentioned in the BOQ I/O summary upto 250 devices compatible.
- Multiple controller (Slave) connectivity.
- Modbus RTU (485/IP) compatible output to BMS.
- Wireless connectivity of devices through WLAN Adaptor/Switch.
- Memory storage through SD card (Optional).
- Downloading updates/via USB interface software utilities – optional, if mentioned in the
  BOQ
- Password Protection.
- The control should have an auto-restart feature which will return the unit to normal operation resumption of mains power.
- Feedback from sensor etc and regulate the fan speed/ valve opening.
- Automatic load / time and alarm sequencing function to be performed by the unit.
- Microprocessor must have output point for ON/OFF of motorized outlet damper and must be suitable to be integrated with fire point for unit shut off incase receiving signal from fire panel or fire detectors.

  In normal operating mode the screen should display unit number, temperature and relative humidity set points and actual, operating status.

Instrumentation: The following sensors shall be part of AHU package for modulation of fan and control valves

a) Temperature Sensor
b) DP sensor across filter

4.1.11 MIXING BOX - OPTIONAL AHU's requiring mixing boxes as specified in Schedule of Quantities shall be complete with fresh and return air dampers.

4.1.12 DAMPER WITH ACTUATOR - OPTIONAL

Dampers shall be opposed blade type. Blades shall be made GI and assembled within a GI frame. All linkages and supporting spindles shall be made of aluminium or nylon, turning in Teflon bushes. Manual dampers shall be provided with a Bakelite knob for locking the damper blades in position. Linkages shall be extended wherever specified for motorized operation. Actuators for manual dampers can be provided as mentioned in the schedule of quantities. Damper frames shall be sectionalized to minimize blade warping. Air leakage through dampers when in the closed position shall not exceed 1.5% of the maximum design air volume flow rate at the maximum design air total pressure. Time delay settings for damper On/Off based on signal from unit controller can be provided.

4.1.13 MULTISTAGE PARTICULATE FILTERATION – OPTIONAL BOQ SPECIFICATION.

Additional filter sections comprising of fine filter (MERV 13) with efficiency of 99% down to 3-micron particle size and other super fine filter to be provided as mentioned in the schedule of quantities.

4.1.14 TESTING AT WORKS – OPTIONAL IF SPECIFIED IN BOQ

Factory performance testing to establish the cooling capacity of the unit, air flow rate, dry bulb and wet bulb temperatures of air entering and leaving the coil of the air handling unit using PLC controlled graphical display. All the results must be fully computerized and can be seen on real time basis. The testing setup shall be in accordance with DIN EN 14511. Minimum 4 hours continuous real time readings should be recorded for computation of operational parameters. Additionally, electrical safety Hi-pod testing, dry run testing for control logic, thermal bridging test and leakage testing of cabinet at works must be complied with as part of performance test of the air handling unit, if Specified in BOQ.

CASSETTE UNIT/S

4-Way Cassette Type Fan coil units complete with decorative panel and cordless remote control. Unit shall have flexible coil selection between 2 Row dia 9.52mm & 3 Rows dia 7mm, now also modulation control function, Fresh air input, ABS fan blower, cleanable fabric filters, High quality main drain tray with inbuilt condensate drain pump, casing, and copper coil headers, coil piping connections through copper pipes., AC Motor- 3 speed fan control, filter and thermostat.

Cassette units are compatible with BMS Inclusive Adaptor/ Controller/ Gateway etc.

5.0 PRECISION AIRCONDITIONING SYSTEMS

5.1 UNITS WITH ELECTRONICALLY COMMUTATED MOTORS AND VARIABLE SPEED

Scope of this section comprises the supply, installation, testing and commissioning of High-Density cooling solution with horizontal throw.

5.2 CABINET CONSTRUCTION

The frame and panels shall be constructed of heavy gauge corrosion resistant sheet steel and have modular construction with aluminium based railing and hinged doors.

The cabinet shall be powder coated and have a textured finish.

The cabinet Shall be provided with acoustic / thermally insulated panels as require with panel of minimum thickness of 1.2mm

The front door shall be of removable hinged construction with provision of required perforation for supply air.

Front door to be provided with horizontal laminar airflow design or with bi-directional throws as per site requirements.

5.3 REFRIGERATION CIRCUIT

The refrigeration system shall be of the direct expansion type and each unit must incorporate independent evaporator coil circuit. Thermal expansion valve is to be provided with flare connection, sight glass and filter drier, shut off valves, shall be provided.

All refrigeration controls including connection to units shall be only with flare or quick coupling connections to ensure no hot works like brazing activity is to be carried out inside the server area. Further incase major failure like internal coil leakage the unity must be suitable to be disconnected via quick couplings and removed outside the critical server area for maintenance / repairs and can be reinstalled without requirement of any shutdown to operating servers/racks.

5.4 EVAPORATOR COIL (DIRECT EXPANSION TYPE)

The evaporator coil shall be constructed of rifled bore copper tubes and louvered aluminium fins, with the frame and drip tray fabricated from heavy gauge steel. The evaporator coil must be minimum six rows deep to handle high temperatures across the coil ranging from air inlet of 30DegC to 37DegC and maintain a leaving temperature with delta of minimum 10DegC and maximum 15DegC. Further since the application is high sensible loads the evaporator must be designed accordingly.

The coil with hydrophilic or varnish coating will be preferred to prevent any water carry if used without sensible loads only as a primary cooling solution. Drip trays are an option bust recommended to be provided as standard option and must be double angled for condensate flow and easily removable for cleaning. The construction of the drip pan must be of stainless steel/aluminum or galvanized steel as per manufacturer's recommendation. The distance between the fins should not be less than 1.8 mm and the face velocity shall not be more than 2.5 m/sec.

5.5 FAN AND MOTOR: ELECTRONICALLY COMMUTATED DRIVES

Fans: Unit must be provided with direct drive backward curved fans each running with DC drive electronically communicated motors, the fans should be aligned and balance statically and dynamically. The fan speed must be controlled based on the room return air Temperatures and also must have automatic speed control without manual intervention.

Units shall be factory balanced in accordance with Section 15071, Mechanical Sound and Vibration Control.

Only direct drive fans with electronically commutated motors are acceptable. The operational logic of the units to take into account that incase of failure of one fan the balance two fans will increase speeds to makeup to best possible extent the loss of airflow due to non-availability of one fan. All the fans to be provided with individual and independent air flow alarm pressure switches which shall shoot alarm to the unit microprocessor in case of airflow failure.

The power to the fan motor must be 24V or 48V DC, however required SMPS/Converters for conversion of main power source from 400V/50Hz/3ph to 24V/48V DC is in scope of equipment supplier. The motors to also be compatible to be powered via UPS supply to ensure ventilation provision in case of loss of power supply to the unit

5.6 SERVICE AREA

The unit shall be serviceable from the front and back via an aisle space of maximum 1 mtr.

5.7 ELECTRICAL HEATING

Considering the units are for use in high density applications, there are not heaters to be equipped with the unit.

5.8 HUMIDIFICATION

In high density applications due to the dominant sensible loads there are not humidifiers to be equipped with the unit.

5.9 AIR FILTRATION

The units shall be provided with washable synthetic air filters with metal frames which can be removed from the unit and taken out of the server area for cleaning and can be installed back into the unit without requiring any shut down of the unit.

Filtration level shall be microbe filters of 90% - 10 microns. Filter clog pressure switch is to be provided to ensure maintenance and up keep of the equipment and also to ensure no reduction in unit capacity resulting from reduced airflow.

5.10 ELECTRICAL PANEL

Control cabinet to be as per OEM design, with grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control circuit transformer.

The construction of the unit electrical panel must be such to also provide space for microprocessor controller and without opening of any panels from the front of the unit the microprocessor panel must have direct access for operation. Return air T/H sensor shall be part of standard supply of the unit.

The electric panel provided for the unit must be equipped with main incoming power isolation switch, additionally the unit must be provided with under voltage / over voltage / phase reversal / single phasing protection, all three phase motors must be operated only via 24V coil voltage contactors and MPCB's, additionally step down transformer must be provided for power supply to the unit controller. The electrical panel must also be providing with relay block for common alarm.

5.11 MICRO PROCESSOR CONTROLLER

Each floor Mounted Evaporator unit must be equipped with individual microprocessor controls with individual display and sensors to comply with below specifications.

5.12 CONTROL TYPE

The controls shall be a microprocessor programmable logic controller. The controls shall have separate indication of operating modes (cooling, heating, humidifying and dehumidifying), alarm conditions (temperature high, loss of sensor, compressor HP & LP, wet floor, no air flow and low humidifier water). The display and indication shall be visible on the front without removing any external panels. Local and remote alarms will be triggered if an alarm condition is reached.

5.13 ALARMS:

The alarm should operate with the audible signal.

Following alarms should be available:

1. Loss of Sensor
2. Compressor 1 High / Low Pressure
3. Wet floor
4. No Air flow
5. Filter clogs
6. Temperature high / low
7. Humidity high / low

The control should have an auto-restart feature which will return the unit to normal operation resumption of mains power. The unit controller must have option of dual set point for energy saving i.e. customer must have the option to set two independent set points for the unit based on operational requirements and energy saving concepts.

5.14 DISPLAY:

In normal operating mode the screen should display unit number, temperature and relative humidity set points and actual, operating status. The unit must have a large screen LCD display on controller with user friendly menus and minimum two-level password protections.

RS485 interface port for BMS with Modbus RTU protocol is required.

6.0 PIPING

6.1 CHILLED WATER PIPING

The Consultant's drawing shows the general layout of the piping. Piping herein specified is meant for Chilled Water and Drain Water Services.

Material	Chilled water	Drain water services
Pipes	M.S. pipe 'C' class as per IS code mentioned in the list	PVC pipe as per the IS Code mentioned in the list

Joining	Weld fitting	Screwed fitting

Sealing 3mm 4 ply non-hardening rubber gasket between Material flanges and Teflon type for threaded joints.

Butterfly valves/balancing valves and ball valves shall be provided as shown in the applicable drawings confirming to following specifications –

Size	Construction	Ends
15mm to 40mm	Ball Valve with forged carbon Steel body & S.S. working parts	Screwed female
50mm & above	Moulded liner cast iron body	Nylon Disc, Seat black nitrile suitable upto 80° C. wafer type confirming to IS - 1536

Check valves shall be provided as shown in the drawings and shall confirm to the following specifications,

Size	Construction	Ends
15mm to 50mm	Gun Metal	Screwed female
65mm & above	Body- Cast iron Disc. & Seat - Gun Metal	Flanged

Swing check valves shall normally be used in all water services and shall confirm to IS - 5312 or BS - 5153. Lift type check valves may be used in horizontal run. Air release and clean out plunger shall be provided and valves shall be suitable for 21 Kg/Cm2 test pressure.

6.2 STRAINERS

Strainer shall be provided at the suction side of pump and chilled water cooling coil. Strainer shall be ISI Marked and preferable of approved type and shall have fabricated steel bodies of ample strength to withstand the test pressure specified for the gate valves.

Strainer shall have flanges for connecting the piping. Strainer shall be designed so as to enable blowing out accumulated dirt & facility of removal & replacement of the screen without disconnecting from main piping. Each strainer shall be provided with equal size isolating valves so that strainer may be cleaned without draining the system.

6.3 PIPING INSTALLATIONS

The drawing indicates schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawing. He must keep in

view the specific opening in building and other structures through which the pipes are designed to pass.

Piping shall be properly supported on or suspended from stands, clamps, hangers etc., as specified & required. The Contractor shall adequately design all the brackets, saddles, clamps, hangers etc. and shall be responsible for their structural integrity. The pipe hangers shall provide vibration free installation.

Pipe support shall not exceed the following spacing -
Maximum Spacing of pipe Supports

Nominal pipe size mm.	25	50	75	100	150	200	300
Maximum span meters	2	3	3.5	4	5	6	6

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. Metal sheet shall be provided between the insulation and clamp, saddle or roller extended at-least 150mm on both sides of the clamp, saddle or roller. High-density polyurethane saddles be used between M.S. angles & pipes.

Vertical piping shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 10mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage.

Pipe sleeve of 50 mm larger than the pipe diameter shall be provided wherever pipe pass through walls and the annular space filled with felt and finished with plaster. Moreover, pipes shall be insulated with Rockwool and fire retardant sealant wherever it crosses fire barricaded walls.

All pipes using screwed fittings shall be accurately out to the required sizes and threaded in accordance with IS - 554 and burrs removed before laying. Open ends of the piping shall be blocked while working to avoid entrance of foreign matter. Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely. In other locations, concentric reducers may be used.

Drains shall be provided at all low points in the piping system and shall be of the following sizes with valves.

Mains	**Drains**
Up to 150mm	25 mm
Over 150 mm	65 mm

Air vents of 15 mm with vent valves of equal size be provided at all high points in the piping system for venting.

6.4 AIR VENTS

Air Vents for Purging of Air Trapped in Piping System Shall Be Provided at the Highest Point. Globe Valves of The Size as Indicated Below Shall Be Provided & No Additional Price Shall Be Paid.

6.5 SUCTION GUIDE

Suction Guide shall be installed at the inlet of each pump. Suction Guide shall have cast iron body, outlet guide vanes, removable SS. Strainer and fine mesh brass start-up strainer.

The Contractor shall inspect the strainer prior to start-up of the pump and shall remove the fine mesh brass strainer after short running period. Space shall be provided for removal of strainer and for connection of blow down valve.

6.6 PRESSURE GAUGES & THERMOMETER

1. Pressure gauges shall be not less than 100 mm dia. & appropriate range and be complete with shut off valves, stainless steel or CP Brass stem etc.

2. Pressure gauge shall be provided to measure the pressure at the following locations: i. On inlet and outlet of each chiller
   ii. Suction and discharge of pumps

3. Care shall be taken to protect pressure gauges during pressure testing.

6.7 EXPANSION JOINTS

Where necessary expansion joints or expansion loops shall be provided to take care of expansion and contraction of pipes due to variation in temperature.

6.8 CENTRIFUGAL TYPE AIR SEPARATOR

An adequately sized Centrifugal type Air separator to remove air from closed chilled water pipe circuit. The unit shall have inlet & outlet connections tangential to the vessel shell. Vessel shell diameter to be three times the nominal inlet/outlet pipe diameter.

The unit shall have an internal stainless-steel air collector tube with 5/32“diameter perforations and 63% open area designed to direct accumulated air to the compression tank via an NPT connection at top of unit. The unit shall have a removable galvanized steel system strainer with 3/16” diameter perforations and a free area of not less than five times the cross-sectional area of the connecting pipe. A blow down connection shall be provided to facilitate routine cleaning of the strainer.

Manufacturer to furnish data sheet specifying air collection efficiency and pressure drop at rated flow.

6.9 TESTING

All water piping shall be tested to hydrostatic test pressure of at-least two times the maximum operating pressure, but not less than 10 Kg/cm2 for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Consultant. Piping repaired subsequent to the above pressure shall be retested in the same method as mentioned above.

6.10 CLEANING OF PIPING

After piping system has been tested and proved tight and leak free, the Contractor shall clean piping system for dirt, scale, oil, grease, waste & other foreign substances which may have accumulated during process of installation. Strainer, screens shall be removed, cleaned and replaced after cleaning process & cleaned after flushing process.

6.11 PASSIVATION OF WATER PIPING

The M. S. pipe line should be passivated by following method-

- Rinse the M. S. pipe line with water 4 times to remove all dust & dirt.
- Circulate mild solution (@5%) of Sulphumic acid or oxalic acid for 24 HRS.
- Rinse the M. S. pipe line with water to remove the acid content.
- Circulate mild solution (@2%) of Caustic soda for 24 HRS and rinse the line with water.
- Circulate solution of SODIUM HEXA META PHOSPHATE in ratio of 10 Gm. per Liter for 12-14 hours.
- Drain the solution and check the pipe surface. If found okay, fill the line again and drain again before final charging of fresh soft water.

A required dozing of Anti Oxidant is required to add periodically.
The sample of water which will be used for the chilled water system shall be analyzed by the successful contractor free of cost. The analysis report shall be submitted to PMC / HVAC Consultant with the recommendation as to any changes in water input is required.

6.12 PAINTING

After all piping has been installed, tested and run for at-least 2 weeks it shall be coated with primer coat and synthetic enamel paints of approved shades as per the colour code.
The direction of fluid flow in the pipes shall be visibly marked with arrow.

7.0 SUPPORTING ARRANGEMENT FOR PIPES / DUCTS

8.1 SUPPORT FROM RCC SLAB

a. DUCT SUPPORTS

Description

Duct should be simply supported by Support Channel made up of cold rolled steel of quality **DX51 or greater & as per EC3 (Eurocode 3) or DIN EN 1993-1-1**.

Support channel should be **pre galvanised with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents & should be monitored according to **RAL - GZ 655-C**.

The Threaded Rods used for the suspension of the Duct should be made up of **partially annealed** medium carbon steel of **grade 4.8 strength class & as per DIN 976 standard.**

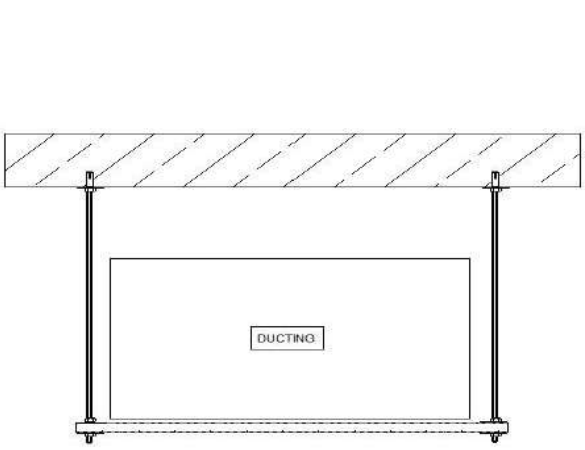
The Drop-in anchors used for the suspension of the rods should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.

Supporting DETAILS for low pressure systems are given below			
Larger Side of Duct mm	**Support Channel mm**	**Vertical Rod Día mm**	**Maximum Spacing between supports mm**
0-600	27x18x1.2	M8	2400
601-1250	38x24x2	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x2.5	M12	2400

Fig.A. Typical Arrangement for Duct Supports from RCC slab



b. CHW PIPE SUPPORTS

Description

The CHW Pipes should be simply supported by **Split Clamps with rubber support insert**.

Split Clamps should be as per **DIN 3567** pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

Rubber support insert should be made from **EPDM or NR/SBR Rubber**
The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB. The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be **pre galvanised with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

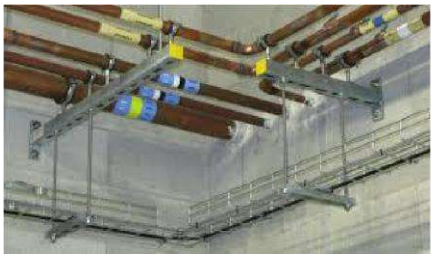
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade **4.8 strength class and as per DIN 976 standard**.

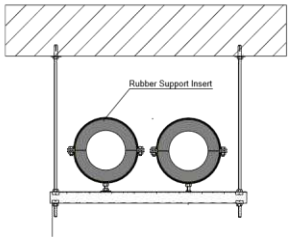
The Drop-in anchors used for the suspension of the rods should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.

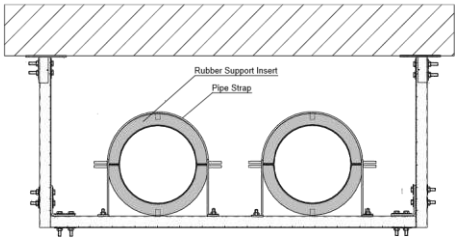
It should be divided into four expansion segments for uniform pressing force distribution in the borehole. The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.8	65	3.7	250	5.0
20	2.4	80	3.7	300	6.1
25	2.4	100	3.7	350	10.0
32	2.7	125	3.7	400	10.5
40	3.0	150	4.5	450	11.0
50	3.0	200	5.6	500	12.0

Typical Arrangement for Pipe Supports from slab







c. DRAIN PIPE SUPPORT

Description

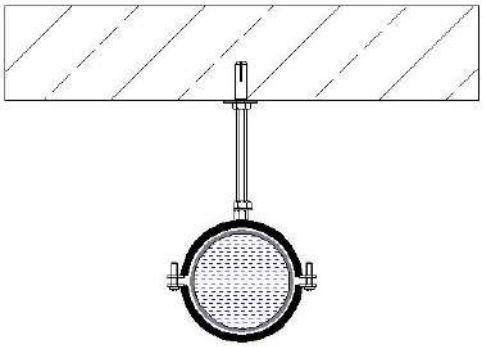
The Drain Pipes should be simply supported by **Split Clamps**.

Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.
The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.
The Drop-in anchors used for the suspension of the rods should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

Maximum Support Spacing (m)					
Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Typical Arrangement for Drain Pipe Supports from slab



8.2 SUPPORT FROM PEB STRUCTURE

a. DUCT SUPPORT

Description

The Duct should be simply supported by Support Channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be pre galvanised with minimum **GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes** on back of the rail.

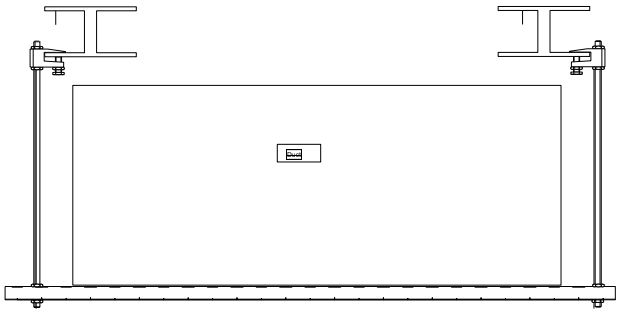
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

The Threaded Rods used for the suspension of the Duct should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.

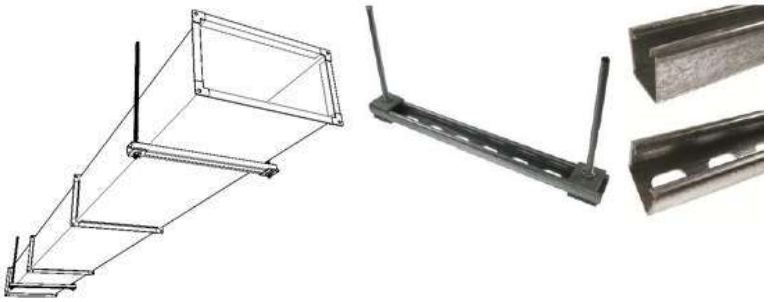
For parallel to beam application.
The Girder cleat for attachment of support channel to steel girder
Girder cleat should be **Vds approved.**
For perpendicular to beam application
The Girder clamp for suspension of threaded pins and threaded rods for support channels.
Girder clamps should be **FM and Vds Approved**.

The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.

Supporting Details for low pressure systems are given below			
Larger Side of Duct mm	**Support Channel mm**	**Vertical Rod Dia mm**	**Maximum Spacing between supports mm**
0-600	27x18x1.2	M8	2400
601-1250	38x24x2	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x2.5	M12	2400



Typical Arrangement for Duct Supports from PEB structure



b. CHW PIPE SUPPORT

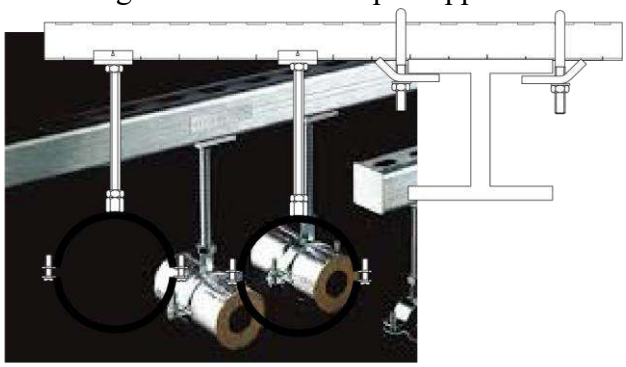
Description

CHW Pipes should be simply supported by **Split Clamps with rubber support insert**.
Split Clamps should be as per **DIN 3567** pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.
Rubber support insert should be made from **EPDM or NR/SBR Rubber**

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.
The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.
In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.**
The Support channel should be **pre galvanised with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.
For parallel to beam application.
The Girder cleat for attachment of support channel to steel girder.
Girder cleat should be **Vds approved.**
For perpendicular to beam application
The Girder clamp for suspension of threaded pins and threaded rods for support channels.
Girder clamps should be **FM and Vds Approved.**
The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	2.5	65	3	250	3
20	2.5	80	3	300	3
25	2.5	100	3	350	3
32	2.5	125	3	400	3
40	2.5	150	3	450	3
50	2.5	200	3	500	3

Typical Arrangement for CHW Pipe Supports from PEB structure



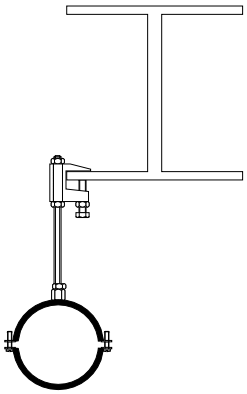
c. DRAIN PIPE SUPPORT

Description

The Drain Pipes should be simply supported by **Split Clamps**.
Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.
The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.
The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.
The Drop-in anchors used for the suspension of the rods should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

Maximum Support Spacing (m)					
Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Typical Arrangement for Drain pipe support from PEB structure



8.3 SUPPORT FROM BUILDING SHAFT

a. DUCT SUPPORTS

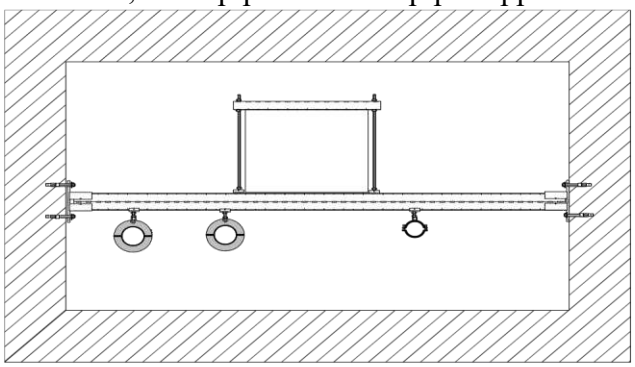
Description

The Duct should be simply supported by Support Channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.**
The Support channel should be **pre galvanised with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.
The Threaded Rods used for the suspension of the Duct should be made up of **partially annealed** medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard.**

The Drop-in anchors or stud anchor used for the suspension of the rods should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole. The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.

Supporting Details for low pressure systems are given below			
Larger Side of Duct mm	**Support Channel mm**	**Vertical Rod Dia mm**	**Maximum Spacing between supports mm**
0-600	27x18x1.2	M8	2400
601-1250	38x24x2	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x2.5	M12	2400

Typical Arrangement for Duct,CHW pipe and drain pipe support from building shaft



b. CHW PIPE SUPPORT: <u>Description</u>

CHW Pipes should be simply supported by **Split Clamps with rubber support insert**.
Split Clamps should be as per **DIN 3567** pre-galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity. Rubber support insert should be made from **EPDM or NR/SBR Rubber.** The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB. The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius. In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.**
The Support channel should be **pre galvanized with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system

compatible **round and long holes on back of the rail**. The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

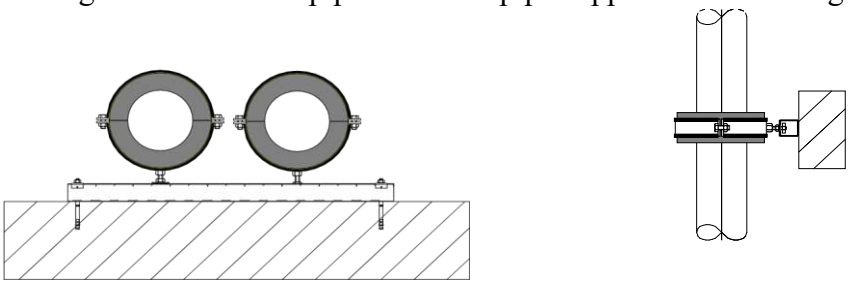
The Threaded Rods used for the fixing Pipe clamp with channel that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard. The Drop-in anchors or stud anchor used for the channel fixing with shaft that should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	2.5	65	3	250	3
20	2.5	80	3	300	3
25	2.5	100	3	350	3
32	2.5	125	3	400	3
40	2.5	150	3	450	3
50	2.5	200	3	500	3

Typical Arrangement for CHW pipe and drain pipe support from building shaft



c. DRAIN PIPE SUPPORT

Description

The Drain Pipes should be simply supported by **Split Clamps**.

Split Clamps should be pre-galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.

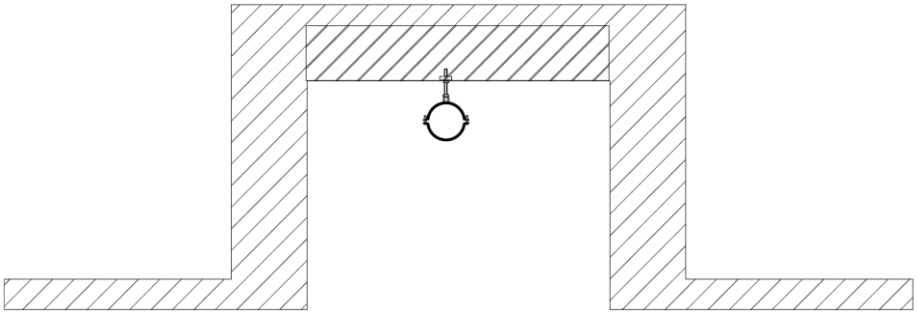
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard.**

The Drop-in anchors or stud anchor used for the suspension of the rods should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

Maximum Support Spacing (m)					
Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Typical Arrangement for drain pipe support from building shaft



SUPPORT ON TERRACE

a. DUCT SUPPORTS

Description

The Duct should be simply supported by Support Channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be **pre-galvanized with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

The Threaded Rods used for the assembly of channel structure that should be made up of **partially annealed** medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard.**

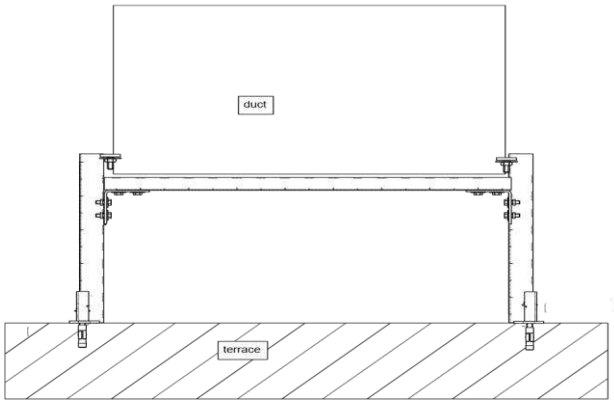
The Drop-in anchors used for the fixing channel with terrace that should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.

Supporting Details for low pressure systems are given below			
Larger Side of Duct mm	**Support Channel mm**	**Vertical Rod Dia mm**	**Maximum Spacing between supports mm**
0-600	27x18x1.2	M8	2400
601-1250	38x24x2	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x2.5	M12	2400

Typical Arrangement for drain pipe support on terrace



 Signature & Seal of Contractor

b. CHW PIPE SUPPORT:

Description

CHW Pipes should be simply supported by **Split Clamps with rubber support insert**.

Split Clamps should be as per **DIN 3567** pre-galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

Rubber support insert should be made from **EPDM or NR/SBR Rubber**

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be **pre-galvanized with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

The Threaded Rods used for the connecting clamp and channel that should be made up of partially annealed medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard**.

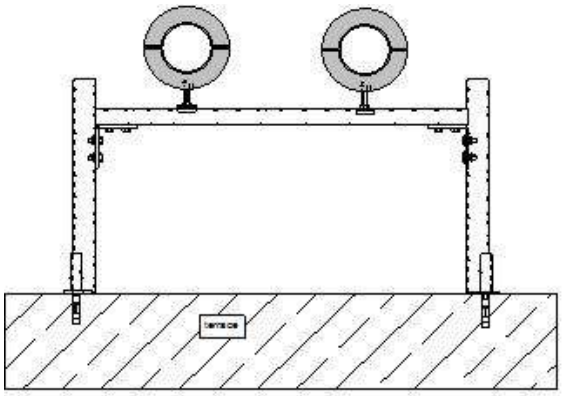
The Drop-in anchors used for the fixing channel with terrace that should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	2.5	65	3	250	3
20	2.5	80	3	300	3
25	2.5	100	3	350	3
32	2.5	125	3	400	3
40	2.5	150	3	450	3
50	2.5	200	3	500	3

Typical Arrangement for CHW pipe support from on terrace



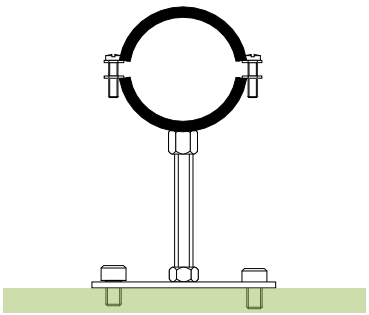
c. DRAIN PIPE SUPPORT

Description

The Drain Pipes should be simply supported by **Split Clamps**.
Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.
The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.
The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard**.
The Drop-in anchors used for the Fixing base plate, should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

Maximum Support Spacing (m)					
Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Typical Arrangement for Drain pipe support from on terrace



8.4 SUPPORT FROM WALL

a. DUCT SUPPORTS

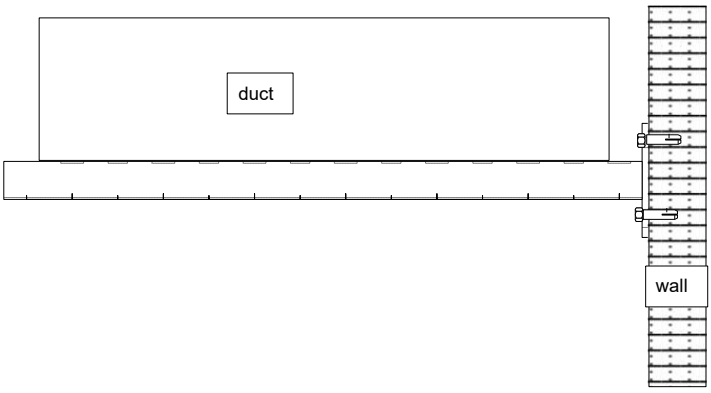
Description

The Duct should be simply supported by Support Channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.**
The Support channel should be **pre-galvanized with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.
The Threaded Rods used for the suspension of the Duct should be made up of **partially annealed** medium carbon steel of **grade 4.8 strength class and as per DIN 976 standard.**
The Drop-in anchors or stud anchor used for fixing with wall that should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the duct and should be provided by the contractor to the consultant for verification.

Supporting Details for low pressure systems are given below			
Larger Side of Duct mm	**Support Channel mm**	**Vertical Rod Dia mm**	**Maximum Spacing between supports mm**
0-600	27x18x1.2	M8	2400
601-1250	38x24x2	M8	2400
1250-2100	38x40x2	M10	2400
2100 and above	40x60x2.5	M12	2400

Typical Arrangement for Duct support from wall



b. CHW PIPE SUPPORT (from wall):

Description

The CHW Pipes should be simply supported by **Split Clamps with rubber support insert**.
Split Clamps should be as per **DIN 3567** pre-galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.
Rubber support insert should be made from **EPDM or NR/SBR Rubber**
The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.
The Clamp and rubber support insert should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1.**

The Support channel should be **pre-galvanized with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

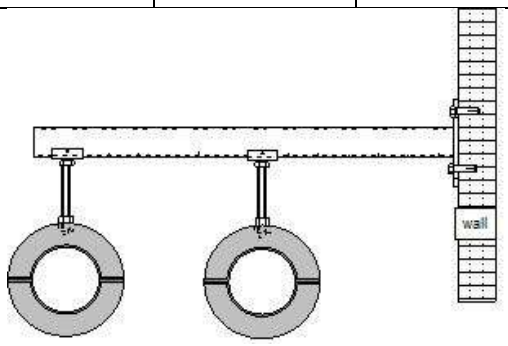
The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of **grade 4.8 strength class & as per DIN 976 standard**.

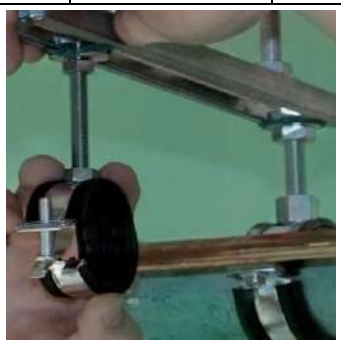
The Drop-in anchors or stud anchor used for Fixing with wall that should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.

It should be divided in four expansion segments of uniform pressing force in borehole.

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	2.5	65	3	250	3
20	2.5	80	3	300	3
25	2.5	100	3	350	3
32	2.5	125	3	400	3
40	2.5	150	3	450	3
50	2.5	200	3	500	3





c. DRAIN PIPE SUPPORT

Description

The Drain Pipes should be simply supported by **Split Clamps**.

Split Clamps should be pre-galvanized and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

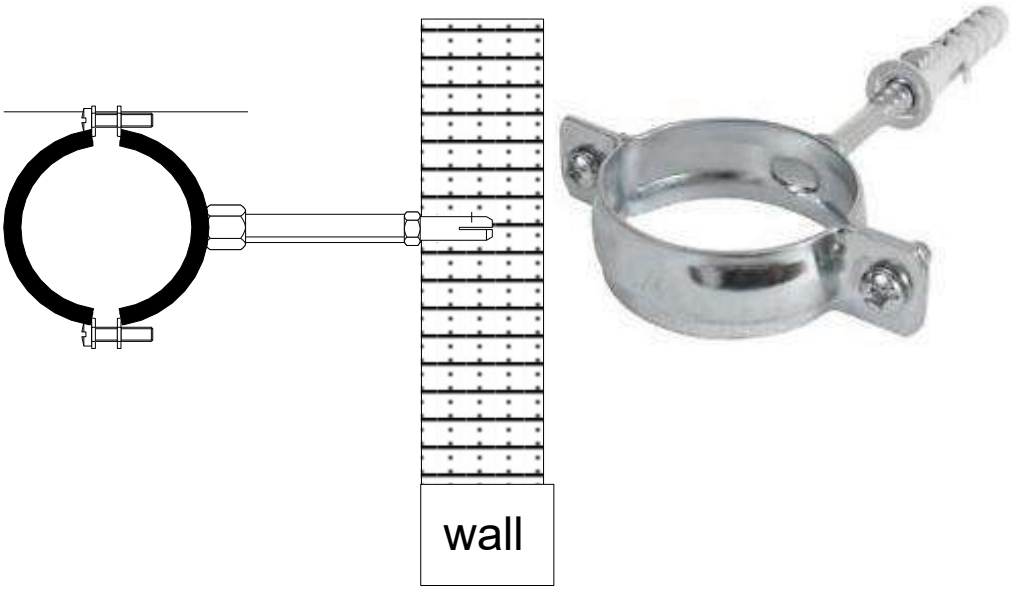
The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to 18 dB.

The Clamp should have temperature capacity of -50 degree Celsius to +150 degrees Celsius.

The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of **grade 4.8 strength class & as per DIN 976 standard**.
The Drop-in anchors or stud anchor used for fixing with wall that should be **ETA (European Technical Approval) with CE mark** for cracked and un-cracked concrete.
It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

Maximum Support Spacing (m)					
Pipe Dia (mm)	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**	**Nominal Pipe Dia (mm)**	**Support Distance (M)**
Upto 15	1.0	32	1.0	65	1.2
20	1.0	40	1.0	90	1.4
25	1.0	50	1,1	80	1.5

Typical Arrangement for Drain pipe support from Wall



8.0 BALANCING VALVE

9.1. SELF BALANCING DYNAMIC FLOW CONTROL VALVES [15-40 MM SIZE]

1. PRESSURE INDEPENDENT DYNAMIC CONTROL VALVE

i. Valve shall be electronic, dynamic, modulating, 2-way, control device.

ii. Dynamic control valve shall accurately control flow, independent of system pressure fluctuation. iii. Maximum flow setting shall be adjustable to 51 different settings within the range of the valve size.

2. VALVE ACTUATOR

i. Valve actuator housing shall be rated to IP 44.

ii. Actuator shall be driven by a 24 VDC motor, and shall accept 2-10 VDC, 0-10 VDC, 4-20 mA, 3-point floating or pulse width modulation electric signal and shall include resistor to facilitate any of these signals.

iii. Actuator shall be capable of providing 4-20 mA or 2-10V DC feedback signal to the control system. iv. External LED read-out of current valve position and maximum valve position setting shall be available.

3. VALVE HOUSING

i. Housing shall be constructed of forged ASTM (CuZn39Pb2) brass rated at no less than 2500 kPa static pressure and 120°C.

ii. Valve housing shall be double union construction with a range of pipe connections available for the appropriate pipe size.

iii. Identification tags shall be available for all valves; tags shall be indelibly marked with part number, production date and pressure differential range. Tags shall be of aluminium and in size 50mm x 25mm.

4. FLOW REGULATION UNIT

i. Flow regulation unit shall consist of stainless steel and hydrogenated acrylonitrile butadiene rubber and shall be capable of controlling flow within +/- 5% of each rated flow. ii. Flow regulation unit shall be accessible, for maintenance.

iii. Optional dual pressure/temperature test plugs for verifying accuracy of flow performance shall be available for all valve sizes.

9.2. SELF BALANCING DYNAMIC FLOW CONTROL VALVES [50-150 MM SIZE]

A. PRESSURE INDEPENDENT DYNAMIC CONTROL VALVE

i. Valve shall be electronic, dynamic, modulating, 2-way, control device.

ii. Dynamic control valve shall accurately control flow, independent of system pressure fluctuation. iii. Maximum flow setting shall be adjustable to 51 different settings within the range of the valve size.

B. VALVE ACTUATOR

i. Valve actuator housing shall be rated to IP 44.

ii. Actuator shall be driven by a 24 VDC motor, and shall accept 2-10 VDC, 0-10 VDC, 4-20 mA, 3-point floating or pulse width modulation electric signal and shall include resistor to facilitate any of these signals.

iii. Actuator shall be capable of providing 4-20 mA or 2-10 VDC feedback signal to the control system.

iv. Optional fail safe system to power valve to either open or closed position from any position in case of power failure shall be available.

v. External LED read-out of current valve position and maximum valve position setting shall be standard.

C. VALVE HOUSING

i. Housing shall be constructed of Ductile Iron ASTM A536-65T, Class 60-45-18 rated at no less than 4000 kPa static pressure and 120°C.

ii. Identification tags shall be available for all valves; tags shall be indelibly marked with part number, production date and pressure differential range. Tags shall be of aluminium and in size 50mm x 25mm.

D. FLOW REGULATION UNIT

i. Flow regulation unit shall consist of 316 Stainless steel and hydrogenated acrylonitrile butadiene rubber and shall be capable of controlling flow within +/-5% of each rated flow.

ii. Flow regulation unit shall be accessible, for maintenance.

iii. Optional dual pressure/temperature test plugs for verifying accuracy of flow.

9.3. SEMI AUTOMATIC DIGITAL BALANCING VALVE

A. TYPICAL SPECIFICATION FOR BALANCING VALVES

1. Balancing valves shall be supplied and installed as shown on the drawings to ensure proper balancing of water flows in the hydronic heating and cooling system.
2. Flow measurement and balancing shall be possible with an accuracy of 4 to 7% in the normal measuring range of the valve. (When valve opening position is more than 50%)
3. Pressure measuring nipples shall be provided for measuring differential pressure and be integral with the body and incorporate means for positive leak tight shut-off when not in use.
4. Adjustment and presetting of flows shall be made with a digital hand wheel.
5. The setting shall be lockable with a mechanical stop to allow the valve to be closed but not opened further than to the pre-set value.
6. For valves in size 10 to 50mm the balancing valves shall offer a facility for draining of water with a separate hose connection and a stop valve. The optional draining facility shall be capable of being mounted on or removed from the balancing valve without interruption to the system operation.
7. Material and Pressure Ratings
   a) Balancing valves with thread connections in sizes from 10 to 50mm shall be made in a dezincification resistant copper alloy with Brinell hardness of at least 130 and a body pressure rating of at least 20 bar (300psi) at 150 degrees C-(AMETAL).
   b) Balancing valves with flange connections from 20 to 300mm shall be made in cast iron equivalent to BS 1452 for a body pressure rating of at least 16 bar –25 bar 150 degrees C. Valves sized 65mm-300mm shall to be fitted with a pressure balanced cone to reduce closing torque to allow the valve to be closed and opened easily.
8. Balancing valves shall be sized to operate in a normal measuring range of 50% to 100% of full opening to ensure maximum accuracy.
9. All the balancing valves shall be manufactured in accordance ISO9001.
10. Certificate of Origin and Certificate of Quality from factory shall be submitted for inspection when the balancing valves are delivered to site before installation.
11. Installation of balancing valves without the specified Certificates shall not be permitted.
12. A computerized balancing instrument (CBI) with ISO9000 calibration certificate shall be handed over after testing & commissioning.

B. CHECKLIST FOR BALANCING VALVES

1. To enable accurate and practical operation, measurement of flow and differential pressure shall be made with a microprocessor instrument which shall enable the operator to read the flow directly without the use of diagrams or tables.
2. The balancing of the system shall be verified in a written report, documenting valve position and water flow which shall be handed over to the consultant for approval and acceptance.

3. The CBI shall have two main components:

An instrument which contains a micro computer, input touch pad and LCD display, and rechargeable batteries and built-in charger. A sensor unit which contain a piezo-resisting pressure sensor, one measurement valve and connection hoses. The measurement valve shall have a safety function which protects the sensor from high differential pressures.

4. In addition to measuring flowrate, differential pressure and temperature, the CBI shall have a computer programme to provide the following functions:-

a. to balance the installation of HVAC system and calculate the necessary valve settings, based on system measurements b. to store the results of balancing

c. to log measured values from a valve (differential pressure, flowrate or temperature)

d. to printout saved data in computerized measurement protocol (CMP) consisting of:

i) Name and size of Balancing Valve (BV)

ii) Presetting position of BV

iii) □P at BV

iv) flow at BV

v) design flow

9.0 FANS

SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of centrifugal, in-line and propeller type fans and roof mounted units conforming to these Specifications and in accordance with the requirement of Drawings and Schedule of Quantities.

TYPE

Centrifugal, in-line propeller fans and roof mounted units shall be of the type as indicated on Drawings and identified in Schedule of Quantities.

CAPACITY

The air-moving capacity of fans shall be as shown on Drawings and in Schedule of Quantities.

FRESH / EXHAUST FAN-

Fresh / Exhaust fan will be heavy-duty industrial type, suitable for three / single-phase power supply and continuous operation with epoxy painting and direct driven motor. The fresh / exhaust air fans shall have casing as that of air handling unit.

All exhaust fans and roof extractor shall be installed as shown in drawing and shall be provided with cowl bend, in take louvers, bird screen etc.

The exhaust fan, cowl bend, in take louvers, bird screen etc. shall be measured as one unit under exhaust fan / roof extractor.

13.1. CENTRIFUGAL FAN

Centrifugal fan shall be DWDI / SWSI Class I construction arrangement 3 (i.e. bearings on both the sides) for DWDI fans complete with access door, squirrel-cage induction motor, V-belt drive, belt guard and vibration isolators, direction of discharge

/ rotation, and motor position shall be as per the Approved-for-Construction shop drawings.

a. Housing shall be constructed of 14 gage sheet steel welded construction. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans, however neoprene / asbestos packing should be provided throughout split joints to make it air-tight.

18 gauge galvanized wire mesh inlet guards of 5 cm sieves shall be provided on both inlets. Housing shall be provided with standard cleanout door with handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.

b. Fan Wheel shall be backward-curved non-over loading type. Fan wheel and housing shall be statically and dynamically balanced. For fans upto 450 mm dia, fan outlet velocity shall not exceed 550 meter/minute and maximum fan speed shall not exceed 1450 rpm. For fans above 450 mm dia, the outlet velocity be within 700 meter/minute and maximum fan speed shall not exceed 1000 RPM. High static pressure fan speed shall be as per manufacturer.

c. Shaft shall be constructed of steel, turned, ground and polished.

d. **Bearings:** shall be of the sleeve / ball-bearing type mounted directly on the fan housing. Bearings shall be designed especially for quiet operation and shall be of the self-aligning, oil / grease pack pillow block type.

e. **Motor:** Fan motor shall be energy efficient and suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, squirrel-cage, totally enclosed, fan-cooled motor, provided with class F insulation, and of approved make. Motor name plate horsepower shall exceed brake horsepower by a minimum of 10%. Motor shall be designed especially for quiet operation and motor speed shall not exceed 1440 rpm.

The fan and motor combination selected for the particular required performance shall be of the most efficient (smallest horse power), so that sound level is lowest.

f. Drive to fan shall be provided through belt with adjustable motor sheave and a standard belt guard. Belts shall be of the oil-resistant type.

g. **Vibration Isolation:** MS base shall be provided for both fan and motor, built as an integral part, and shall be mounted on a concrete foundation through resistoflex vibration isolators. The concrete foundation shall be at least 15 cm above the finished floor level, or as shown in approved-for-construction shop drawings.

13.2. AXIAL FLOW FAN

Fan shall be complete with motor, motor mount, belt driven (or direct driven) and vibration isolation type, suspension arrangement as per approved for construction shop drawings.

a. **Casing:** Casing shall be constructed of heavy gage sheet steel. Fan casing, motor mount and straightening vane shall be of welded steel construction. Motor mounting plate shall be minimum 15 mm thick and machined to receive motor flange.

An inspection door with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be bonderized, primed and finish coated with enamel paint.

b. **Rotor:** Rotor hub and blades shall be cast aluminium or cast steel construction. Blades shall be die-formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Fan blades mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control may be manually readjusted at site upon installation, for obtaining actual air flow values, as specified and quoted.

c. **Motor:** Motor shall be energy efficient squirrel-cage, totally-enclosed, fan cooled, standard frame, constant speed, continuous duty, single winding, suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, provided with class `F' insulation. Motor shall be specially designed for quiet operation. The speed of the fans shall not exceed 1000 RPM for fans with impeller diameter above 450 mm, and 1440 RPM for fans with impeller diameter 450 mm and less. For lowest sound level, fan shall be selected for maximum efficiency or minimum horsepower. Motor conduit box shall be mounted on exterior of fan casing, and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit.

d. **Drive:** to fan shall be provided through belt drive with adjustable motor sheave and standard sheet steel belt guard with vented front for heat dissipation. Belts shall be of oil resistant type.

e. **Vibration Isolation:** The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of rubber-in.

13.3. PROPELLER FAN

Propeller fan shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orifice ring.

a. **Mounting Plate** shall be of steel construction, square with streamlined venture inlet (reversed for supply applications) coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge sheet steel depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.

b. **Fan Blades** shall be constructed of aluminium or steel. Fan hub shall be of heavy welded steel construction with blades bolted to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at the manufacturer's works.

c. **Shaft** shall be of steel, accurately ground and shall be of ample size for the load transmitted and shall not pass through first critical speed thru the full range of specified fan speeds.

d. **Motor** shall be standard (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans 60 cm dia or larger and 1440 rpm for fans 45 cm dia and smaller. Motors for larger fans shall be suitable for 415±6% volts, 50 cycles 3 phase power supply, and for smaller fans shall be suitable for 220 ± 6% volts, 50 cycles single phase power supply. Motors shall be suitable for either horizontal or vertical service as indicated on Drawings and in Schedule of Quantities.

e. **Accessories:** The following accessories shall be provided with propeller fans:

i. Wire guard on inlet side and bird-screen at the outlet.

ii. Fixed or gravity louvers built into a steel frame at the outlet. iii. Regulator for controlling fan speed for single phase fan motor.
iv. Single phase preventors for 3 phase fans.

10.0 SHEET METAL WORK-

11.1 SMACNA STANDARDS

Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards – Metal and Flexible – Second Edition – 1995"-SMACNA). All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill Test Certificates. Galvanizing shall be of 120gms/sq.m. (Total coating on both sides). In addition, if deemed necessary, samples of raw material, selected at random by owner's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.

11.2 SELECTION OF G.I. GAUGE AND TRANSVERSE CONNECTORS

Duct Construction shall be in compliance with 1" (250 Pa) w.g. static norms as per SMACNA. All transverse connectors shall be the 4-bolt slip-on flange system standard makes of similar 4-bolt systems with built-in sealant.

The specific class of transverse connector and duct gauge for a given duct dimensions will be as per Table given below for the 1" (250 Pa) pressure class.

Non-toxic, AC-applications grade P.E. or PVC Gasketing is required between all mating flanged joints. Gasket sizes should conform to flange manufacturer's specification.

SMACNA STANDARDS						
FOR SELECTION OF FLANGE CLASS AND DUCT GAUGES **AT 1200 MM SPACING**						
Duct Dimension	**Duct Pressure in Inches / (Pascal)**					
	1"(250)*5	**2"(500)**	**3"(750)**	**4"(1000)**	**6"(1500)*4**	**10"(2500)**
(in mm)	**Reinforcement Class - Duct Gauge**					
upto 250	*3E-26	E-26	E-26	E-26	E-26	E-24
251-300	E-26	E-26	E-26	E-26	E-24	E-24
301-350	E-26	E-26	E-26	E-26	E-24	E-22
351-400	E-26	E-26	E-26	E-26	E-24	E-22
401-450	E-26	E-26	E-26	E-26	E-24	H-20
451-500	E-26	E-26	E-24	E-24	E-24	H-20
501-550	E-26	E-26	E-24	E-24	H-24	H-20
551-600	E-26	E-26	E-24	E-24	H-22	H-20
601-650	E-26	E-26	E-24	E-24	H-22	H-20
651-700*2	E-26	E-26	E-24	H-24	H-22	H-18
701-750	E-26	E-26	E-24	H-24	H-22	J-18
751-900	E-26	E-24	H-22	H-22	H-20	J-18
901-1000	E-26	H-24	H-22	H-20	J-18	J-16
10 01-1200	E-24	H-22	H-20	J-18	J-18	
12 01-1300	*3H-24	H-20	J-18	J-18	J-16	
13 01-1500	H-24	H-18	J-18	J-16	NOT	

15 01-1800	H-22	J-18	J-16
18 01-2100	*3J-20	*3J-20	
2101-2400	J-18	J-18	
2401-2700	J-18		

GNED

Notes:

***1- SMACNA** – Sheet Metal & Air conditioning Contractors' National Association Inc – "HVAC Duct Construction Standards- Metal and Flexible"-1995, U.S.A.

***2- Reading Guide**- For duct sizes between, say, 651 mm and 700 mm, when the pressure class is 1" w.g. static, we require a standard 'E' class flange and duct gauge of 26. For the same size range but with static pressure at 4" w.g. a standard 'H' class flange with duct gauge of 24 should be used.

***3-** The standard flange classes available are designated E, H and J. For E & H class of standard make use gasket size 10 mm wide and 4.5 mm thick. For standard J-class use 15 mm wide and 6 mm thick gasket.

11.3 DUCT CONSTRUCTION

The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.

Dimensional Tolerances: All fabricated dimensions will be within +/- 1.0mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be +/- 1.0 mm per meter.

Each and every duct pieces should be identified by color coded sticker which shows specific part numbers, job name, drawing number, duct sizes and gauge . Ducts shall be straight and smooth on the inside. Longitudinal seams shall be airtight and at corners only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness

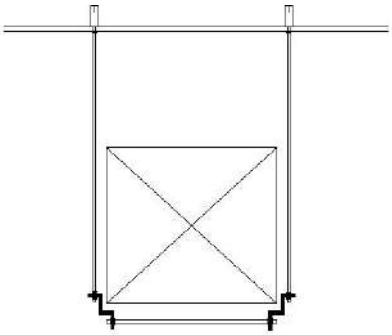
Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

Plenums shall be shop/ Reinforcement of ducts shall be achieved by either cross breaking or straight beading depending on length of ducts

As per SMACNA page no. 1.74, fig. 1-8 "Duct Sizes 19" (483 mm) wide and larger which have more than 10 ft² of unbraced panel shall be beaded or cross broken unless ducts will have insulation covering or acoustical liner. This requirement is applicable to 20 G (1.00 mm) or less and 3" W.G. (750 Pa) pressure or less. Ducts for 4" W.G. (1000 Pa) or more do not require beads or cross-breaks." factory fabricated panel type and assembled at site.

11.4 SUPPORT FOR HORIZONTAL RECTANGULAR DUCT

Sr. No.	Maximum Duct Size (mm)	Hanger Rod Diameter	Interval (mm)
1	Upto - 700	6 mm	2400
2	701 - 1200	8 mm	2400
3	1201 - 2000	10 mm	2400
4	Above 2000	12 mm	2400



As an alternative, slotted galvanized brackets attached to the top two bolts of the Rolamate system may also be used as appropriate for the site condition. To provide the required thermal brake effect, Neoprene or equivalent material of suitable thickness shall be used between duct supports and duct profiles in all supply air ducts not enclosed by return air plenums.

11.5 INSTALLATION PRACTICE

All ducts shall be installed as per tender drawings and in strict accordance with approved shop drawings to be prepared by the Contractor. The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these specifications and drawings. The work shall meet with the approval of Owner's site representative in all its parts and details.

All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in the building whether or not the same are shown on the drawings. Where there is interference/fouling with other beams, structural work, plumbing and conduits, the ducts shall be suitably modified as per actual site conditions.

Ducting over false ceilings shall be supported from the slab above, or from beams. In no case shall any duct be supported from false ceilings hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.

Where ducts pass through brick or masonry openings, it shall be provided with 25mm thick appropriate insulation around the duct and totally covered with fire barrier mortar for complete sealing.

All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge.

TESTING

After duct installation, a part of duct section (approximately 5 % of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA - "HVAC Air Duct Leakage Test Manual" (First Edition)

11.6 LOW LEAK DAMPER-

Damper shall be opposed blade type, blades shall be made of double skinned aerofoil Aluminium (G.I. for ventilation) sections with integral gasket and assembled within a rigid extruded Aluminium alloy frame.

All linkages and supporting spindles shall be made of Aluminium or nylon, turning in Teflon bushes and linkages shall be extended for motorized operation wherever specified. Manual dampers shall be provided with a Bakelite knob for locking the damper blades in position. Damper frames shall be sectionalized to minimize blade warping.

Air leakage through dampers when in the closed position shall not exceed 1.5 % of the maximum design volume flow rate at the maximum design pressure.

11.7 PERFORATED FACE DIFFUSER

Diffusers should be constructed from Aluminium frames and perforated face plates. The diffuser cores are removable type and damper operation from front. They should be suitable to fit in grids of tile type false ceiling.

INSTALLATION

A good quality neoprene rubber of uniform thickness and width shall be used as gasket between flange joints. The felt shall be fixed by a suitable adhesive and holes made by passing a heated rod through. The slope of the duct shall be such that the rainwater cannot enter the premise i.e. the slope of duct shall be towards the outside wall to prevent rainwater entry. Special care shall have to be taken by the contractor in the time of erection.

i. All ducts shall be rigid and shall be adequately supported and where required with standing seams, tees or angles of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing. All the joints shall be made airtight by soldering & all interior surfaces shall be smooth. Bends shall be made with radius not less than one half the width of the duct or with properly designed interior curved vanes. Where metal ducts or sleeves terminate in woodwork, brick or masonry openings, and tight joints shall be made by means of closely fitting heavy flanged collars.

Ducting over false ceiling shall be supported from the slab above or from beams. In no case a duct is to be supported from the false ceiling hangers or to be permitted to rest on a hung ceiling.

ii. All holes concrete, masonry etc. made by contractor for fixing supports etc. shall be made good and restored to original finish by him.

iii. Air handling units and fans shall be connected to duct work by inserting at air inlet and air outlet a double canvass sleeve. Each sleeve shall be minimum 100 mm long, securely bolted to duct and units. Each sleeve shall be made smooth and the connecting ductwork rigidly held in line with unit inlet or outlet.

11.8 GRILLES AND DIFFUSERS

All grilles (SA & RA), diffusers (SA & RA) will be made from heavy gauge extruded Aluminium sections duly powder coated to match the interior requirements of Architect/Client. All the supply air grilles/ diffusers will be provided with opposed blade dampers fabricated from galvanized steel sheet painted in two coats of matt black stowing enamel paint. The damper should be suitable for operation from front face of grille/diffuser.

TESTING

The entire air distribution system shall be balanced to supply the air quantities as required in various zones and rooms to maintain the specified room conditions. The

final balancing of air quantity through each grille or diffuser shall be recorded and submitted to the Consultant / Employer for approval.

PAINTING

Angle iron flanges, stiffeners, hangers and supports shall be painted with two coats primer and those remaining uncovered further two coats of synthetic

11.9 DAMPERS-

All dampers shall be of 18 S.W.G. G.I sheets louver dampers of robust construction and tight fitting. The design, method of handling and control, shall be suitable for the location and service required. Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation, control or setting in any desired position. Dampers and their operating devices shall be made robust, easily operable and accessible through suitable access door. Every damper shall have indication device clearly showing the damper position at all times. All the bushing will be of brass only.

A fire damper shall be provided between each air handling unit room and the rest area and at crossing of fire rated walls. The fire dampers shall be confirming to UL-655 and other applicable fire codes. The dampers shall be operated through either fusible link or solenoid valve.

11.10 FIRE & SMOKE DAMPERS

a. All supply and return air ducts at AHU room crossings and at all floor crossings shall be provided with Motor operated Fire & smoke damper of at least 90 minutes rating as per
UL555/1995 tested by CBRI. These shall be of multi-leaf type and provided with Spring
Return electrical actuator having its own thermal trip for ambient air temperature outside the duct and air temperature inside the duct. Actuator shall have Form fit type of mounting, metal enclosure and guaranteed long life span.

b. Fire damper blades and outer frames shall be of 16G galvanized steel construction fitted with 18 gage extended sleeves on both sides. The damper blade shall be pivoted on both ends using chrome plated spindles in self lubricated bronze bushes. Stop seals shall be provided on top and bottom of the damper housing made of 16G galvanized sheet steel. For preventing smoke leakage metallic compression seals will be provided.

c. The electric actuator shall be energized either upon receiving a signal from smoke detector installed in AHU room supply air duct/ return air duct or temperature sensor. The fire damper shall also close upon sensing temperature rise in supply air ducts thru the electronic temperature sensor.

d. Each damper shall be provided with its own control panel, mounted on the wall and suitable for 240 VAC supply. This control panel shall be suitable for spring return actuator and shall have at least the following features:

- Potential free contacts for AHU fan ON/ Off and remote alarm indication.
- Accept signal from external smoke / fire detection system for tripping the electrical actuator.
- Test and reset facility.
- Indicating lights / contacts to indicate the following status:
- Power Supply On

- Alarm
- Damper open and close position.

e. Actuators shall be mounted on the sleeve by the damper supplier in his shop and shall furnish test certificate for satisfactory operation of each Motor Operated Damper in conjunction with its control panel. Control panel shall be wall mounted type.

f. It shall be HVAC Contractor's responsibility to co-ordinate with the Fire Alarm System Contractor for correctly hooking up the Motor Operated Damper to Fire Detection / Fire Management System. All necessary materials for hooking up shall be supplied and installed by HVAC Contractor under close co-ordination with the fire protection system contractor.

g. HVAC Contractor shall demonstrate the testing of all Dampers and its control panel after necessary hook up with the fire protection / fire management system is carried out by energizing all the smoke detectors with the help of smoke.

h. HVAC Contractor shall provide Fire retardant cables wherever required for satisfactory operation and control of the Damper.

i. HVAC Contractor shall strictly follow the instructions of the Damper Supplier oravail his services at site before carrying out testing at site.

j. Fire/smoke damper shall be provided with factory fitted sleeves; however, access doors shall be provided in the ducts within AHU room in accordance with the manufacturer's recommendations.

k. The Contractor shall also furnish to the Owner, the necessary additional spare actuators and temperature sensor (a minimum of 5% of the total number installed) at the time of commissioning of the installation.

11.11 Supply & Return Air Registers

Supply & return air registers shall be of either steel or aluminium sections as specified in schedule of quantities. Steel construction registers shall have primer Coat finish whereas extruded aluminium registers shall be either Anodized or Powder Coated as specified in Schedule of Quantities. These registers shall have individually adjustable louvers both horizontal and vertical. Supply air registers shall be provided with key operated opposed blade extruded aluminium volume control damper anodized in matt black shade.

The registers shall be suitable for fixing arrangement having concealed screws as approved by Architect. Linear continuous supply cum return air register shall be extruded aluminium construction with fixed horizontal bars at 15 Deg. inclination & flange on both sides only (none on top & bottom). The thickness of the fixed bar louvers shall be minimum 5.5 mm in front and 3.8 mm in rear with rounded edges. Flanges on the two sides shall be 20 mm/30 mm wide as approved by Architect. The grilles shall be suitable for concealed fixing. Volume control dampers of extruded aluminium anodized in black colour shall be provided in supply air duct collars. For fan coil units horizontal fixed bar grilles as described above shall be provided with flanges on four sides, and the core shall be & suitable for clip fixing, permitting its removal without disturbing the flanges.

a. All registers shall be selected in consultation with the Architect. Different spaces shall require horizontal or vertical face bars, and different width of margin frames. These shall be procured only after obtaining written approval from Architect for each type of register.

b. All registers shall have a soft continuous rubber/foam gasket between the periphery of the register and the surface on which it has to be mounted. The effective area of the registers for air flow shall not be less than 66 percent of gross face area.

c. Registers specified with individually adjustable bars shall have adjustable pattern as each grille bar shall be pivot-able to provide pattern with 0 to +45 degree horizontal arc and upto 30 degree deflection downwards. Bars shall hold deflection settings under all conditions of velocity and pressure.

d. Bar longer than 45 cm shall be reinforced by set-back vertical members of approved thickness.

e. All volume control dampers shall be anodized aluminum in mat black shade.

11.12 GRILLES AND DIFFUSERS-

All grilles (SA & RA), diffusers (SA & RA) will be made from heavy gauge extruded Aluminum sections / M.S. (As specified in the BOQ) duly powder coated to match the interior requirements of Architect / Client. All the supply air grilles/diffusers will be provided with opposed blade dampers fabricated from Al. The damper should be suitable for operation from front face of grille/diffuser.

INSTALLATION-

A good quality felt/expanded polyethylene /rubber of uniform thickness and width shall be used as gasket between flange joints. The gaskets shall be fixed by a suitable adhesive and holes made by passing a heated rod through.

1. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angles of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing. All the joints shall be made tight and all interior surfaces shall be smooth. Bends shall be made with radius not less than one half the width of the duct or with properly designed interior curved vanes where metal ducts or sleeves terminate in woodwork, brick or masonry openings, tight-flanged collars. Ducting over false ceiling shall be supported from the slab above or from beams. In no case a duct shall be supported from the false ceiling hangers or to be permitted to rest on a hung ceiling.
2. All holes in concrete, masonry etc. made by contractor for fixing supports etc. shall be made good and restored to original finish by him.
3. Air handling units and fans shall be connected to duct work by inserting at air inlet and air outlet a double canvass sleeve. Each sleeve shall be minimum 100mm long, securely bolted to duct and units. Each sleeve shall be made smooth and the connecting ductwork rigidly held in the line with unit inlet or outlet.

TESTING AND BALANCING

After the installation of the entire air distribution system is completed in all respects, all ducts shall be tested for air leaks by visual inspection.

The entire air distribution system shall be balanced using an anemometer. Measured air quantities at fan discharge and at various outlets shall be identical to or less/excess than 5 percent in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be

submitted for scrutiny and approval, and four copies of the approved balance report shall be provided with completion documents.

PAINTING-

Angle iron flanges, stiffeners, hangers and supports shall be painted with 2 coats of anti rust primer and those remaining uncovered shall be further painted with 2 coats of synthetic enamel paints of black colour enamel paints of approved color.

11.13 FLEXIBLE DUCTING

The scope of this section comprise supply, installation, testing and commissioning of flexible ducting conforming to this specification & in accordance with the requirements of drawings and schedule of quantities.

Wherever specified un-insulated flexible duct shall be made of double lamination of Metalized Polyester film permanently bonded to a coated spring steel wire helix. Duct shall be tear & puncture resistant construction.

Wherever insulated flexible duct are specified inner core for the same should be made of double lamination of Metalized Polyester film permanently bonded to a coated spring steel wire helix. Fiber glass insulation of minimum 14 kg/cu meter density having R-value 4.2° F - Ft² - hr/Btu & 32 mm thickness shall be wrapped over the inner core & covered with strong outer jacket cum vapor barrier made of fiberglass reinforced Metalized polyester film laminate.

Care must be taken to install the entire flexible duct in fully extended position & bends made with adequate radius as per manufacturer recommended practices.

Duct should confirm to Australian Fire Standard AS 4254.

11.0 PRE-INSULATED DUCTS

Pre-Insulated Ducting shall be fabricated from 20 mm thickness air duct panel sheet having dimensions of 3000 (Length) mm by 1200 (Width) mm and produced and Sandwiched with Polyisocyanurate (PIR) first quality insulating Foam having 35 Kg / m^3 density. The Ducting Sheet shall have Lacquered & Embossed Aluminium facing on both sides.

Insulating foam material shall be Expanded Rigid Polyisocyanurate foam having closed cell content not less than 95%, CFC/ HCFC free, Non-Toxic, Non-combustible, zero ozone depletion, Zero Global Warming Potential and Non ignitable.

Ducting panels shall comply with following or equivalent standards and manufacturer should produce M1 & F1 certification for Fire & Toxicity test results.

- BS 476:PART6—Fire Propagation for Products
- BS 476:PART7---Surface Flame Spread (Class1)
- Class O Fire Rating as per Building Regulation requirements.
- Thermal Conductivity Coefficient at 10^0C--0.022 W/m.K
- Smoke Opacity Index—lessthan10
- Rigidityclass:200000Nmm^2/mm
- Water vapor permeability of laminations=0

All required accessories; Connecting Flanges, Invisible Bayonet, Adhesive, Sealant, Duct Supports (as per clause 5.2) shall be part of ducting work for fabrication of the HVAC ducting in Square, rectangle, radius, offset construction etc., appropriate sizes

of Aluminium flanges with self-adhesive good quality gasket shall be provided as a joinery or connection of duct pieces.

All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with hangers formed of galvanized steel wire ropes (as per clause 5.2) and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel wire hangers under ducts, rigid supports may be provided at certain interval if need be. The spacing between supports should be not greater than 3.0 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates or Toggle end wire fixing left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the wire rope hanger shall be welded to the plates. Trapeze hanger formed of galvanized steel wire rope using self-grip double channel lock shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Wire rope supports shall hang through the cleats or wire rope threaded studs can be screwed into the anchor fasteners.

Excellent quality Silicon Neutral Sealant of Approved make along with fire rated PVC corners shall be used for sealing of all joints & corners.

Complete ducting shall be installed incorporating duct supports such as galvanized angles, threaded rods, self adhesive brackets, Etc.

12.1. PANELSPECIFICATION: -

Description	Internal Areas	External Areas of Building
Dimensions of panel	3000x1200mm	3000x1200mm
Thickness of panel	20 mm	20/30 mm
Thickness of aluminium laminations	60/60microns	60/200microns
Density of the foam	35kg/m^3	35kg/m3
Surface finish	Embossed/Embossed	Embossed/Embossed
Anti-rust lacquer	2gm/m^2bothsides	2gm/m2 both sides

12.2. PRE-INSULATED DUCTING - ECO+

Smart PIR(Eco+) Ducting system (Using SandwichedPanels Of Polyisocyanurate Foam between Aluminium Foils)

The duct shall be fabricated out of sandwiched panels made up of CFC / HCFC Free **P**oly **I**socyanurate **R**igid **F**oam between Aluminium Foils as per the parameters given below: -

A. DUCT MATERIALS SPECIFICATIONS

The duct shall be fabricated out of sandwiched panels made up of embossed aluminium foils (anti microbial, anti fungal, anti dust and uv protection coating) on

both sides with pin holes perforation internally to increase acoustic property and in between sandwiched with PIR foam. Insulating foam material shall be Expanded Rigid Polyisocyanurate Foam having closed cell content not less than 95%, CFC/ HCFC free, Non-Toxic, Non Combustible, Zero Ozone Depletion, Zero Global Warming Potential and Non Ignitable as per the parameters given below:

Physical Characteristics of the panels shall be as follows:

Comfort Cooling Application		
Thickness of Panels	**Air-conditioned Areas**	
	20	Mm
Thickness of Aluminium	80 /80	Microns
Density of the Foam- Minimum	51	kg/m³
Finishing of Aluminium	Embossed	Embossed

B. INTERNAL AREAS (AIR-CONDITIONED SPACE NOT EXPOSED TO SUNLIGHT):

20MM THICK PANEL

Irrespective of Duct size Stiffening should be provided for the duct size above 1000mm. Both sides of the Aluminium foils should act as vapour barrier.

The said panel material should be test certified for **Fire Properties** by competent authority:

1) It should be certified for 'for Class 'O' according to BS 476 Part 6& 7 by Authorized International Fire Testing Laboratories i.e. 'Warrington Fire Laboratories, UK & US.
2) It should be certified for similar Fire properties by Authorized Indian fire test laboratories i.e. C.B.R.I, Roorkee.
3) For Flame Spread Index it should be certified for Class "A" certification as per 'ASTM E84' by relevant international authorities.
4) For Smoke Developed Index, it should be certified for Class "A" certification as per 'ASTM E84' and similar safety codes by relevant international authorities.
5) Toxicity Index shall not exceed 5.7 according to 'NES 713' by international fire testing laboratories i.e. 'WARRINGTON FIRE LABORATORIES, UK. 6) The Panel should have 2 hours fire rating.
7) The Duct should comply have EN 13403 certification.

The Panel Manufacturer should additionally comply with following **Quality and Operational Standards** for not only panels but accessories also:

1) ISO 9001:2008 for Quality Management System
2) ISO 14001:2004 for Environmental Management System

PRESSURE RANGE:

No relevant modification of insulation, chemical or physical characteristics of the panels to be measurable, when conveying air up to the pressure of 2000 Pascal for 20 mm thick panels.

THERMAL INSULATION CHARACTERISTICS:

Thermal insulation characteristics shall be as follows:

- Physiologically and chemically inert and insoluble.
- Vermin proof.
- Fungus proof.
- Non-Metabolisable.
- Thermal Conductivity: 0.019 W/mK at Delta 30°C.
- Water Absorption shall be less than 0.5% by 24 hours immersion test.

TEMPERATURE RANGE:

No relevant reduction of insulation, chemical or physical characteristics of the panels to be measurable, when conveying air in the temperature range of –45°C to +150°C.

EXTENDED WARRANTY ON INSULATION CHARACTERISTICS:

Original Panel Manufacturer should offer 10-years Warranty for the Insulation material Characteristics.

DUCT ACCESSORIES:

All the duct accessories like duct jointing profiles, profile inserts, adhesives, sealants, aluminium tape, GI corner and Polymer covers of profiles are to be used from the original Duct Panel Manufacturers only to achieve accuracy and best efficiency in construction of duct.

DUCT FABRICATION AND INSTALLATION STANDARDS:

The ducts shall be fabricated as per the drawing provided by manufacturer team and should be supplied at site in Boxed form and should be complete with all suitable joint fittings & profiles, inserts, using proper adhesive and sealing arrangements etc.

Changes in section of duct work shall be affected by tapering the ducts with as long a taper
as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the Engineer – In – Charge.

For bigger Duct sizes Internal Stiffener arrangement with tiger clamp to be provided for rigidity.

GOVERNING STANDARDS:

Unless otherwise specified here, all duct work shall be provided with adequate pre fabricated hangers or support and to prevent vibrations.

All ducts shall be supported from the ceiling / slab/ Purlins by means of wire and lock type system (manufacture recommended), with suitable capacity.

INSTALLATION SUPERVISION:

Installation shall be Supervised &Certified by the Manufacturer's representative.

JOINT SYSTEM:

The joints between the ducts shall be using polymer invisible flanges and slide-in-channel to be used and to be connected by special cover corners, having a holding

pin, which goes inside the flange and the insulation, to avoid any field connection and to give the system more strength.

Ductwork shall be installed, using supports, as described in DW144 & according to manufacturer's requirements. Maximum distance between supports shall not exceed:

 4000mm for ducts with section not exceeding 1200 x 1000mm. 2000mm for ducts with section exceeding 1200 x 1000mm.

All duct work shall be of high quality approved PIR Sheets guaranteed not to crack or peel on bending or fabrication of ducts. Care should be taken at site so that the Aluminum foil covering the panel is maintained intact during Installation to ensure Vapour Barrier continuity.

All joints shall be air tight and shall be made in the direction of air flow. All duct joints shall be inserted with exact size cut inserts to suit the profiles and corners should be covered with PVC caps.

Fixing of Pre Insulated Ducts with various ducting items like Volume Control Dampers or Fire dampers etc. shall be done using Polymer Flanges of the desired type.

REINFORCEMENTS:

Appropriate number of internal stiffening of Threaded Bar, Nut and Bolt and load distribution GI Discs for very large ducts are provided.

For positive pressure (supply ducts) and for negative pressure (return ducts) load distributing GI Discs are placed externally and internally for better strength.

Reinforcements will be fixed perpendicular to the larger duct dimension. These will be installed on ducts exceeding 1000 mm W/H any dimension, as per following spacing.

- 1200 – 1500 – 1 No x 1/2 - 1/2
- 1500 – 1800 – 2 Nos x 1/4 – 1/2 -1/4
- 1800 – 2100 – 3 Nos x 1/6 – 1/3 – 1/3 – 1/6
- 2100 – 2400 – 4 Nos x 1/8 – 1/4 – 1/4 – 1/4 – 1/8

However, as per site requirement and constraints, certain duct pieces can be fabricated and made at site using the same above standards to suit pieces.

Great care should be taken to ensure that the ducting work does not extend outside and beyond height limits as noted on the drawings.

The ducting work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the Engineer – In – Charge. The contractor shall verify all measurements at site and shall notify the Engineer – In – Charge.

12.0 INSULATION

FOR G.I. DUCTING - SPECIFICATION FOR THERMAL & ACOUSTIC INSULATION

SCOPE

The scope of this section comprises the supply and application of insulation conforming to these specifications.

13.1 DUCT THERMAL INSULATION

MATERIAL

1. Insulation material shall be Closed Cell Elastomeric **NITRILE RUBBER**
2. Density of Material shall be between 40 to 60 Kg/m3
3. Thermal conductivity of elastomeric NITRILE RUBBER shall not exceed 0.**034** W/m. K at mean temperature of 0□C
4. Insulation material shall have anti-microbial product, which is EPA (Environmental Protection Agency), USA approved, as an integral part of insulation that cannot be washed off or worn off. **(NITRILE RUBBER is anti-Microbial polymer)**
5. It shall give enhanced level of protection against harmful Microbes such as bacteria, mold, mildew and fungi and should confirm to following standards: Fungi Resistance – ASTM G21 and Bacterial resistance – ASTM G 22 / ASTM 2180.
6. Insulation shall have fire performance such that it passes **ASTM–E–84 test** Method
7. Material should be FM (Factory Mutual), USA approved.
8. Water vapor permeability shall not exceed 1.74 x 10-14 Kg / (m.s.Pa), i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum 10000.

Thickness of the insulation shall be as specified for the individual application.

THICKNESS SELECTION CHART FOR NITRILE RUBBER INSULATION Design Basis: Condensation Control	
OUTDOOR, ATTIC & UNCONDITIONED SPACES VENTED TO OUTDOOR Design Conditions: 32 Deg. C & 85% RH (as per ASHRAE guidelines)	
DUCT INSULATION	
Duct	**Required Thickness (mm)**
Supply Air Duct (Line Temperature 14 Deg.C)	25
Return Air Duct (Line Temperature 22 Deg.C)	25

THICKNESS SELECTION CHART FOR NITRILE RUBBER INSULATION Design Basis: Condensation Control	
INDOOR (CONDITIONED / SEMICONDITIONED AREAS) Design Conditions: 26.8 Deg.C & 85% RH (With Proper Ventilation)	
DUCT INSULATION	
Duct	**Required Thickness (mm)**

Supply Air Duct (Line Temperature 14 Deg.C)	19
Return Air Duct (Line Temperature 22 Deg.C)	13
Supply Air Duct in Return Air Path (Line Temp. 14 Deg.C)	13

THICKNESS SELECTION CHART FOR NITRILE RUBBER INSULATION	
Design Basis: Condensation Control	
Non - Coastal Areas Pune, Delhi, Hyderabad, Bangalore etc.	
DUCT INSULATION	
Duct	**Required Thickness (mm)**
Supply Air Duct (Line Temperature 14 Deg.C)	19
Return Air Duct (Line Temperature 22 Deg.C)	13
Supply Air Duct in Return Air Path (Line Temp. 14 Deg.C)	13

External thermal insulation shall be provided as follow:

The thickness of the NITRILE RUBBER shall be as shown on drawing or identified in the schedule of quantity. Following installation procedure should be adopted:

1. Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work.
2. Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubbers sheets to size with sufficient allowance in dimension.
3. Material shall be fitted under compression and no stretching of material should be allowed.
4. A thin film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface.
5. When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond.
6. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
7. The adhesive shall be strictly as recommended by the manufacturer.
8. Detailed Application specifications are as per the manufacturer's recommendation.

13.2 INSTALLATION OF DUCTS EXPOSED DIRECTLY TO SUNLIGHT:

For installations exposed to sunlight, after giving 36 hours curing time for the adhesive apply manufacturer's recommended UV/Mechanical Protection. Please refer the separate detailed guidelines on UV/Mechanical Protection.

13.3 INSULATION FOR CHILLED WATER/DRAIN PIPING

The complete chilled water piping including with pipes, bends, flanges, valves, hanger support etc. will be insulated as per the following –

MATERIAL

1. Insulation material shall be Closed Cell Elastomeric Nitrile Rubber

2. Density of Material shall be between 40 to 60 Kg/m3
3. Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.035 W/m□K at an average temperature of 0□C
4. The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations
(England & Wales) and the Building Standards (Scotland) Regulations 1990
5. Material should be FM (Factory Mutual), USA approved.
6. Thickness of the insulation shall be as specified for the individual application.
7. Water vapor permeability shall not exceed 0.017 Perm inch (2.48 x 10-14 Kg/m.s.Pa), i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum 7000.
8. All chilled water, refrigerant and condensate drain pipe shall be insulated in the manner specified herein.
9. An air gap of 100 mm shall be present between adjacent insulated surfaces carrying chilled water or refrigerant & also between the insulated surface & the wall to allow natural ventilation without affecting its external surface coefficient of heat transfer.
10. Before applying insulation, all pipes shall be brushed and cleaned. All Pipe surfaces shall be free from dirt, dust, mortar, grease, oil, etc.

Nitrile Rubber insulation shall be applied as follows:

a. Insulating material in tube form shall be sleeved on the pipes.
b. On existing piping, slit opened tube of the insulating material (slit with a very sharp knife in a straight line) shall be placed over the pipe and adhesive shall be applied as suggested by the manufacturer.
c. Adhesive must be allowed to tack dry and then press surface firmly together starting from butt ends and working towards centre.
d. Wherever flat sheets shall be used it shall be cut out in correct dimension. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
e. The insulation shall be continuous over the entire run of piping, fittings and valves.
f. All valves, fittings, joints, strainers, etc. in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and application shall be same as above. Valves bonnet, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.

The detailed application specifications are as mentioned separately. The manufacturer's trained installer should only be used for installation.

RECOMMENDED ADHESIVE:

In all cases, the manufacturer's recommended Adhesive should be used.

13.4 PUMP INSULATION

Chilled water pumps shall be insulated to same thickness as pipe to which they are connected & application shall be same as above. Care shall be taken to apply insulation in a manner as to allow dismantling of pumps without damaging insulation.

13.5 SHELL INSULATION

Chiller shells shall be factory / site insulated in accordance with manufacturer's stds.

COLD WATER AND EXPANSION TANK INSULATION

Cold water tank, and chilled water expansion tank shall be insulated as per manufacturer's standard.

PIPE SUPPORTS

All pipe supports should be factory made as detailed specification attached.

13.6 INSTALLATION EXPOSED DIRECTLY TO SUNLIGHT:

For installations exposed to sunlight, after giving 36 hours curing time for the adhesive apply manufacturer's recommended UV/Mechanical Protection. Please refer the separate detailed guidelines on UV/Mechanical Protection.

THICKNESS SELECTION CHART FOR NITRILE RUBBER INSULATION Design Basis: Condensation Control	
OUTDOOR, ATTIC & UNCONDITIONED SPACES VENTED TO OUTDOOR Design Conditions: 28.3 Deg. C & 90% RH (as per ASHRAE guidelines)	
CHILLED WATER PIPING LINE TEMP 7 Deg.C	
Pipe NB (mm)	**Required Thickness (mm)**
25 to 40	32
50 to 150	38
200 to 600	44
Cold Water Tank	44

REFRIGERANT PIPING LINE TEMP 3 Deg C	
Pipe NB (mm)	**Required Thickness (mm)**
Up to 50	38
Up to 100	44

DUCT INSULATION	
Duct	**Required Thickness (mm)**
Supply Air Duct (Line Temperature 14 Deg. C)	23
Return Air Duct (Line Temperature 22 Deg. C)	8

THICKNESS SELECTION CHART FOR NITRILE RUBBER INSULATION Design Basis: Condensation Control	
INDOOR (CONDITIONED / SEMICONDITIONED AREAS) Design Conditions: 26.8 Deg.C & 85% RH	
CHILLED WATER PIPE LINE TEMP (7 Deg.C)	
Pipe NB (mm)	**Required Thickness (mm)**
Up to 65	19

Up to 600	25

DRAIN PIPING LINE TEMP (15 Deg.C)	
Pipe NB (mm)	**Required Thickness (mm)**
Up to 50	13

REFRIGERANT PIPING LINE TEMP 3 Deg C	
Pipe NB (mm)	**Required Thickness (mm)**
Up to 40	25
Up to 100	32

DUCT INSULATION	
Duct	**Required Thickness (mm)**
Supply Air Duct (Line Temperature 14 Deg.C)	19
Return Air Duct (Line Temperature 22 Deg.C)	9
Supply Air Duct in Return Air Path (Line Temp. 14 Deg.C)	9

THICKNESS SELECTION CHART FOR NITRILE RUBBER INSULATION	
Design Basis: Condensation Control	
OUTDOOR & INDOOR	
Design Conditions: 30 Deg. C & 82 % RH	
CHILLED WATER PIPE LINE TEMP (7 Deg.C)	
Pipe NB (mm)	**Required Thickness (mm)**
Up to 32	19
Up to 600	25
Chilled Water Tank	25

DRAIN PIPING LINE TEMP (15 Deg.C)	
Pipe NB (mm)	**Required Thickness (mm)**
Up to 50	13

REFRIGERANT PIPING LINE TEMP 3 Deg C	
Pipe NB (mm)	**Required Thickness (mm)**
Up to 50	25
Up to 100	32

DUCT INSULATION	
Duct	**Required Thickness (mm)**

Supply Air Duct (Line Temperature 14 Deg. C)	19
Return Air Duct (Line Temperature 22 Deg. C)	9
Supply Air Duct in Return Air Path (Line Temp. 14 Deg.C)	9

13.7 ACOUSTIC INSULATION

1. Material shall be engineered NITRILE RUBBER open cell foam
2. The Random Incidence Sound Absorption Coefficient (RISAC); tested as per ISO 354, should be minimum as per enclosed chart

Freq (Hz)	125	250	500	1000	2000	4000	NRC
10 mm	0.03	0.04	0.14	0.04	0.88	1.00	0.35
15 mm	0.01	0.09	0.29	0.74	1.08	0.83	0.55
20 mm	0.04	0.13	0.4	0.9	1.04	0.90	0.60
25 mm	0.02	0.25	0.86	1.14	0.88	0.99	0.80
30 mm	0.07	0.32	0.99	1.16	0.93	1.08	0.85
50 mm	0.23	0.73	1.29	0.99	1.09	1.11	1.05

3. The material should be fiber free
4. The density of the same shall be within 140-180 Kg/m3
5. It should have antimicrobial product protection, and should pass Fungi Resistance as per ASTM G 21 and Bacterial Resistance as per ASTM E 2180.
6. The material should have a thermal conductivity not exceeding 0.047 W/m. K @ 20 Deg. C
7. The material should withstand maximum surface temperature of +850C and minimum surface temperature of -200C
8. The material should conform to Class 1 rating for surface spread of Flame in accordance to BS 476 Part 7 & UL 94 (HBF, HF 1 & HF 2) in accordance to UL 94, 1996.
9. The insulation should pass Air Erosion Resistance Test in accordance to ASTM Standard C 1071-05 (section 12.7).
   Thickness of the material shall be as specified for the individual application. The insulation should be installed as per manufacturer's recommendation.

13.8 INTERNAL (ACOUSTIC) INSULATION OF AHU WALLS:

Acoustic insulation shall be provided for the AHU walls.

Insulation material shall be Glass Wool insulation boards of thickness 25 mm and density 70-80 kg / m3 and faced One Side FSK & Other side Black Glass Cloth. The thermal conductivity (K) value shall not be more than 0.031 W/m K at 10 deg. C. The channels used for supporting shall be 20 G GSS.

Mechanical fasteners shall be used to ensure adherence of insulation to Channel.

13.9 DUCT ACOUSTIC LINING

Ducts so identified and marked on Drawings and included in Schedule of Quantities shall be provided with acoustic lining of thermal insulation material for a distance of minimum 5 meters.

INSTALLATION PROCEDURE

The inside surface for the ducts shall be covered with adhesive recommended by the manufacturer. Cut Foamed sheets into required sizes apply adhesive on the foam and stick it to the duct surface

A. ARMAFLEX PROTECT R 90 - THE FIRE-STOP PENETRATION SEAL FOR PIPES

The flexible fire stop pipe seal with a fire resistance of > 90 min. for noncombustible/combustible supply pipes and/or non-combustible waste pipes in solid ceilings/walls or light weight walls.

Create fire-resistant seals for pipework using closed-cell, flexible elastomeric insulation with intumescent effect

The material should have following properties-

Temperature Range: -50 Deg. C to +85 Deg.C
Thermal Conductivity: 0.05 W/m. K at 0 Deg.C
Water Vapor Diffusion Factor $\mu < 10,000$
Reaction to Fire: B2 in accordance to DIN 4102
Fire reaction to structural element: R 30 to R 90
(in accordance to prEN 1366-3.2: N185 2007-07 and DIN EN 13501-2: 2008-01, section
7.5.8)

INSTALLATION:

The intumescent insulation is to be either sleeved over the pipe or slit and sealed using manufacturer's recommended adhesive. Longitudinal seams and butt joints are to be covered with EPDM / NITRILE RUBBER rubber self-adhesive tape. The gap remaining between the insulation and the wall/ceiling is to be closed completely using mineral mortar. In lightweight walls, the gap is closed using loose fill within the wall and filler against the gypsum board (annular gap up to 50 mm).

The length of the intumescent insulation is to be determined depending on the pipe material and diameter according to manufacturer's recommendation as per the standard / test report for the R 90 test.

The Pipe diameters above 89 mm can be insulated with sheets which are additionally fixed with the binding wire (wound around 6 times per running meter). Binding of wire should be done for tubes as well.
Installation with zero clearance between the insulated pipes is permitted in the area of penetration is permitted. In case of chilled water lines condensation aspect should be considered.

Work should be carried out in accordance with relevant R 90 testing standard / test report.

13.10 PIPE SUPPORT WITH ARMAFIX

SPECIFICATION CLAUSE:

Insulated pipe support, single piece with self-adhesive closure, PUR/PIR load bearing Insert (Density 140 -180 kg/m³) embedded in elastomeric EPDM / NITRILE RUBBER rubber insulation with two outer metal shells made of aluminum sheet, which also acts as a vapor barrier for the PUR/PIR inserts.

TECHNICAL DETAILS -

Temperature Range : -50°Cto+105°C
Moisture Resistance Factorμ : 5000
Thermal Conductivity at 0°C : 0.035W/(m·K)
Thermal Conductivity at 40°C : 0.039 W/(m · K)
Color : Black

13.11 UV / MECHANICAL PROTECTION FOR PIPING / DUCTING / VESSEL

a) Covering with ... Arma-ChekGC

SPECIFICATION CLAUSE:

For protection against mechanical impact and Scratch – treated woven glass fiber covering - should be applied.
(For Indoor application only)

TECHNICAL DETAILS -

Temperature Range : -50°Cto+150°Coverall
Temperature Range Rubber Insulation : - 50°C to +105°C If based on EPDM / Nitrile Rubber
Temperature Range Rubber Insulation : - 50°C to +150°C If based on EPDM / Nitrile Rubber
Color : Black
Density : 205+10gms/sq.meter

APPLICATION NOTES:

The covering should be cut to size according the circumference of the insulated pipe – please allow an additional 50mm for the overlap of the covering material. The Overlap shall be securely fixed using recommended Adhesive.

Spread thin film of recommended on the 50mm overlap and close the seam. When covering fittings, please consult the manufacturer's Application Manual. All fittings have to be covered to the same standards as the covering of the pipe work. No additional vapor barrier is needed.

b) Covering...with Arma-ChekCL

SPECIFICATION CLAUSE:

For protection against mechanical impact & scratch, a lightweight, Aluminum foil with woven glass fiber reinforcement covering –- with a good resistance to Oil and Chemicals - should be applied. (For Indoor application only)

TECHNICAL DETAILS -

Temperature Range : -50°Cto+150°Coverall
Temperature Range Rubber Insulation : - 50°C to +105°C If based on EPDM / NITRILE RUBBER
Temperature Range Rubber Insulation : - 50°C to +150°C If based on EPDM / NITRILE RUBBER
Dust & Fiber Free
Color : Silver

APPLICATION NOTES:

The covering should be cut to size according the circumference of the insulated pipe – please allow an additional 50mm for the overlap of the covering material. The Overlap shall be securely fixed using recommended Adhesive.

Spread thin film of recommended on the 50mm overlap and close the seam. When covering fittings, please consult the manufacturer's Application Manual. All fittings have to be covered to the same standards as the covering of the pipe work. No additional vapor barrier is needed.

c) ArmaChek T - (with UV Resistant Paint and CSM) It's a two component composite system of Chopped Strand Mat (CSM) and special UV resistant paint.

PROCEDURE:

i. Apply UV paint liberally on Insulation.
ii. Immediately spread the 225 GSM Chopped Strand Mat (with minimum overlap of 1 inch at joints) on insulation without allowing paint to dry.
iii. Immediately apply another coat of paint liberally on CSM.
iv. Even out with brush and allow it to dry for 2-3 hours.

Note: Mechanical Protection should be applied after 36 hours of Curing of adhesive. It is the minimum time required for complete curing of adhesive.

13.12 FALSE CEILING INSULATION

The false ceiling shall be insulated with 50 mm thick fiberglass slab of 16 Kg. / Cu. M. density. The fiberglass slab shall be wrapped in polyethylene bags.

13.13 UNDERDECK INSULATION

MATERIAL

Insulation material shall be Closed Cell Elastomeric **NITRILE RUBBER**

1. Density of Material shall be between 40 to 60 Kg/m3
2. Thickness of the insulation shall be 25mm.
3. Thermal conductivity of elastomeric EPDM / NITRILE RUBBER shall not exceed **0.034** W/m.K at mean temperature of 0□C
4. Insulation material shall have anti-microbial product, which is EPA (Environmental Protection Agency), USA approved, as an integral part of insulation that cannot be washed off or worn off. **(NITRILE RUBBER is anti-Microbial polymer)**
5. It shall give enhanced level of protection against harmful Microbes such as bacteria, mold, mildew and fungi and should confirm to following standards: Fungi Resistance – ASTM G21 and Bacterial resistance – ASTM G 22 / ASTM 2180.
6. The insulation shall have fire performance such that it passes **ASTM-E-84 test** Method.
7. Material should be FM (Factory Mutual), USA approved.
8. Water vapor permeability shall not exceed 1.74 x 10-14 Kg / (m.s.Pa), i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum 10000.

13.14 AHU ROOM ACOUSTIC INSULATION

1. Material shall be engineered NITRILE RUBBER open cell foam
2. The Random Incidence Sound Absorption Coefficient (RISAC); tested as per ISO 354, should be minimum as per enclosed chart

Freq (Hz)	125	250	500	1000	2000	4000	NRC
20 mm	0.04	0.13	0.4	0.9	1.04	0.90	0.60

3. The material should be fiber free.
4. The density of the same shall be within 140-180 Kg/m3.
5. It should have antimicrobial product protection, and should pass Fungi Resistance as per ASTM G 21 and Bacterial Resistance as per ASTM E 2180.
6. The material should have a thermal conductivity not exceeding 0.047 W/m.K @ 20 Deg.
   C.
7. The material should withstand maximum surface temperature of +850C and minimum surface temperature of -200C.
8. The material should conform to Class 1 rating for surface spread of Flame in accordance to BS 476 Part 7 & UL 94 (HBF, HF 1 & HF 2) in accordance to UL 94, 1996.
9. The insulation should pass Air Erosion Resistance Test in accordance to ASTM Standard C 1071-05 (section 12.7).
10. Thickness of the material shall be as specified for the individual application.
11. The insulation should be installed as per manufacturer's recommendation.

13.15 CAVITY/RAISED FLOOR INSULATION

MATERIAL

1. Insulation material shall be Closed Cell Elastomeric Nitrile Rubber.

2. Density of Material shall be between 40 to 60 Kg/m3.
3. Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.037 W/m□K at an average temperature of 0□ C.
4. The insulation shall have fire performance such that it passes CLASS 1 as per BS476 Part 7 for surface spread of flame as per BS Standards & B-1 as per DIN Standards.
5. Water vapor permeability shall not exceed 0.03 Perm inch (2x 10-10 Kgs/m.hr.Pa).
6. Thickness of the insulation shall be 25 mm.

INSTALLATION PROCEDURES

1. First the supports for raised floor should be installed on to the floor. Then the floor shall be cleaned with brush to remove all dirt, cement etc. If floor is uneven it should be made smooth prior to carrying out insulation work.
2. Allow an additional 5 mm to the total dimensions while cutting Insulation sheet. Ensure you measure the cutting dimensions on the top surface of the insulation sheet. This can be identified by the products markings; "they are always on the top surface. This surface is the one you will see after installation.
3. All Insulation sheet and floor surfaces shall have all-over adhesive coverage. Adhesive should be applied on the side that has no product markings and identification printing. This side is the one that curves inwards.
4. During installation avoid air bubbles. Always apply pressure on fixing the Insulation sheet, this action will ensure maximum bond strength.
5. All cut Insulation sheet edges shall be of a "clean cut nature & not cut rough".
6. All seams and joint shall be sealed with SR 505 adhesive. All seams and joints should have no more than 10mm of adhesive showing on the outer skin of the finished Insulation sheet installation.
7. Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubbers sheets to size with sufficient allowance in dimension. Material shall be fitted under compression and no stretching of material shall be permitted. A thin film of adhesive shall be applied on floor with brush and then on to the back of the insulating material sheet with brush/small piece of sheet metal having smooth edges. When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond. All joints shall be sealed. SR 505 adhesive of Pidilite should be used for all cavity floor applications.

13.0 CROSS TALK SILENCER

The cross talk silencer should incorporate aerodynamic side lines with erosion protected class "O" acoustic in fills covered with perforated sheet metal. The casing should be manufactured as per DW 142 class B code and should be of galvanized sheet metal 1 mm thick to BS 2989 grade Z2 G275.

14.0 ENCLOSURES FOR CONTROLLERS AND ELECTRICAL PANELS

All the controllers shall be housed in Lockable Vandal proof boxes which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust and vermin proof and suitable for tropical climatic conditions. The panel shall be metal enclosed 14 SWG CRCA sheet steel cubicle with gaskets between all adjacent units and beneath all covers to render the joints dust proof. All doors and covers shall be hinged and latched and shall be folded and braced as necessary to provide a rigid support. Joints of any kind in sheet metal shall be seam welded with welding slag grounded off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and secured with the frame and holes in the panels correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with nuts. Self threading screws shall not be used in the construction of control panels. Knockout holes of approved size and number shall be provided in the panels in conformity with the location of incoming and outgoing conduits/cables. lamps shall be provided to support the weight of the cables. The dimension of the boxes shall depend on the requirement with the color decided in consultation with the Architect/Consultant.

Note: All panel enclosures used in plant room spaces and external to building shall be suitable for outdoor application (IP 54 protection) and UL listed.

15.0 CONDUITS AND WIRING

Prior to laying and fixing of conduits, the contractor shall carefully examine the drawings indicating the layout, satisfy himself about the sufficiency of number and sizes of conduits, sizes and location of conduits and other relevant details. Any discrepancy found in the drawings shall be brought to the notice of Architect/Engineers Any modifications suggested by the Contractor shall be got approved by the Architect /Engineers before the actual laying of conduits is commenced.

16.1 CONDUITS / TRUNKER

Conduits and accessories shall conform to relevant Indian Standards. PVC conduits of required dia shall be used as called for in the schedule of quantities. Joints between conduits and accessories shall be securely made, with help of adhesive. The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

16.2 CONNECTIONS

All jointing methods shall be subject to the approval of the Architect/Engineer. Separate conduits shall run for all power wiring. The threads and sockets shall be free from grease and oil.

Connections between conduit and controller metal boxes shall be by means of brass hexagon smooth bore bush, fixed inside the box and connected through a coupler to the conduit. The joints in conduits shall be smooth to avoid damage to insulation of conductors while pulling them through the conduits.

16.3 BENDS IN CONDUIT

Where necessary, bends or diversions may be achieved by means of bends and/or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with a finished wall surface. No bends shall have radius less than 2-1/2 times the outside diameter of the conduit.

16.4 FIXING CONDUITS

The conduits, junction boxes, outlet boxes and controller boxes once installed in position, shall have their outlets properly plugged or covered so that water, mortar, insects or any other foreign matter does not enter into the conduit system. Surface conduits shall be fixed by means of spacer bar saddles at intervals not more than 500 mm.

The saddles shall be 2 mm x 19 mm galvanized steel flat, properly treated, primer coated & painted, securely fixed to supports by means of nuts and bolts/rawl bolts and brass machines screws.

16.5 DRAWING OF CONDUCTORS

While drawing insulated wires/cable into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. No joint shall be allowed in case of breakage of any conductor. No joint shall be shaved off like length of the conductors. Insulation shall be shaved off like sharpening of a pencil and it shall not be removed by cutting it square to avoid depression/cutting of conducting material.

Strands of wires shall not be cut to accommodate & connect to the terminals. Terminals shall have sufficient cross-sectional area to take all the strands.

No wire shall be drawn into any conduit until all work of any nature that may cause injury to wire is completed. Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction. Where wires are connected to detectors, or panel, sufficient extra length of wires shall be provided to facilitate easy connections and maintenance. If numbers of cables are > 4 than cable tray of appropriate size to be used.

Only licensed supervisors/wiremen shall be employed for cabling and other connected work. Only approved make of cables shall be used. The cables shall be brought to the site in original packing.

16.0 SIGNAL CABLING & COMMUNICATION CABLING

The signal cable shall be of the following specifications:

a) Wire : Annealed Tinned Copper
b) Size : 1.5 sq. mm, 7 strands
c) No. of conductors : Two (One pair)
d) Shielding : Overall beld foil Aluminium polyester shield.
e) Jacket : Chrome PVC
f) Nominal DCR : 17.6 ohm/km for conductor
57.0 ohm/km for shield
g) Nominal OD : 8.5 mm
h) Nominal capacitance : 130 pF/m between conductors at 1 KHz180 pF/m between one conductor and other conductors connected to shield.
i) Color : Black and Red

17.1 COMMUNICATION CABLE

The communication cable shall be of the following specifications:

a) Wire : Annealed Tinned Copper
b) Size : Minimum 24 AWG stranded
c) No. of conductors : Two pair (4 conductor)
d) Shielding : Overall beld foil Aluminium polyester shield.
e) Jacket : Chrome PVC
f) Nominal DCR : 78.7 ohm/km for conductor 55.8 ohm/km for shield
g) Nominal OD : 5.64 mm

h) Nominal capacitance : 131 pF/m between conductors @ 1 KHz, 243 pF/m between one conductor and conductors connected to shield other

i) Color : Black and Red, Black and White)

17.2 LOCAL AREA NETWORK CABLE

Depending on the type of LAN system being used by the contractor, standard, manufacturer's specification shall apply for CAT 5 / CAT 6 cable.

B ELECTRICAL WORKS

1.0 LT CABLES -1.1KV GRADE

1.1 GENERAL

The cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, Specifications, relevant Indian Standard and cable manufacturer's instruction.

1.2 MATERIAL

Specification of 1.1KV grade Single / Multicore XLPE insulated, PVC sheathed Aluminium / Copper conductor Armoured / Unarmoured cables shall be as per IS: 7098 Part-1:

i. Conductor:

- Material : Aluminium / Copper : Electrolytic grade
- Shape : Aluminium : 6 & 10 sqmm.
- Solid circular conductor : 16 sqmm. & above stranded compacted shaped
- Copper conductor : 4 & 6 sqmm. stranded non-compacted
- Circular : 10 sqmm. stranded compacted
- Circular : 16 sqmm. & above stranded compacted shaped

ii. Insulation Material: Cross linked polyethylene XLPE (Red, Yellow, Blue & Black)

iii. Inner Sheath: Extruded inner PVC sheath

iv. Armouring: Single layer of galvanized steel round wires / flat strips v. Outer sheath: FR-LSH PVC Sheath vi. Colour of sheath: Black

Note: Single core armoured cables shall be with "Non-magnetic" type armouring.

1.3 CABLE LAYING AND HANDLING

It should be ensured that both ends of the cable are properly sealed to prevent ingress / absorption of moisture.

1.4 CABLE HANDLING

When cable drums have to be moved over short distance, they should be rolled in the direction of the arrow marked on the drum.

While removing cables, the drums shall be properly mounted on jacks or on a cable wheels or any other suitable means, making sure the spindle, jack etc. are strong enough to take the weight of the drum.

The cables shall not be given a sharp bend to a small radius. The minimum safe bending radius for all types of PVC/XLPE cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable, larger radius should be adopted. At joints and terminations, the bending radius of individual cores of a multicore cable shall not be less than 15 times its overall diameter.

Cable with kinks and straightened kinks, or with similar apparent defects like defective armoring etc. shall not be installed / laid.

Cables of different voltages as well as power and control cables should be kept in different trenches/racks with adequate separation. Where available space is restricted, LV/MV cable shall be laid above HV cables.

Where cables cross over cannot be avoided, the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

Installation of cables including jointing shall be carried out as per IS: 1255 amended and revised to date.

Power and communication cables shall, as far as possible cross at right angles. Where power cables are laid in proximity to communication cables, the horizontal and vertical clearances shall not normally be less than 60 cm.

Cables shall be laid direct in ground, in pipes / closed ducts, in open ducts or on surface depending on environmental conditions, and as required in schedule of quantities.

During the preliminary stages of laying the cable, consideration should be given to proper location of the joint position so that when the cable is actually laid, the joints are made in the most suitable places and as approved by Consultant. As far as possible, water logged locations, carriage ways, pavements, proximity to telephone cables, gas or water mains, inaccessible places, ducts, pipes, racks, etc. shall be avoided.

The cable shall not in any circumstances be bent so as to form an abrupt right angle but must be rounded off at the corners to a radius not less than 12 times the overall diameter of the cable.

In case, where there are chances of any damage to the wiring/cables, such wiring/cables shall be covered with a sheet metal protective covering (not less than 16 SWG), the base of the covering being flush with the plaster or brickwork as the case may be, or the wiring /cables shall be drawn through a heavy gauge metal conduit pipe by complying with all the requirements of conduit wiring system.

Such protective covering shall, in all cases, be fitted on all down drops within 1.5 m from the floor or from floor level upto the switch board, whichever is less.

While cutting and stripping of the outer sheathing of the cable, care shall be taken that the sharp edge of the cutting instrument does not touch the inner insulation of the conductors. The protective outer covering of the cable shall be stripped off near connecting terminal and this protective covering shall be maintained upto close proximity of connecting terminals. The cables laid near junction boxes shall be made moisture proof with a plastic compound.

1.5 CABLE JOINTING & TERMINATION

Jointing shall be as per the manufacturer's recommendations using standard kits. Cable joints shall be made in suitable, approved cable joint boxes, jointing of cables in the joint boxes and filling of compound shall be done as per manufacturer's recommendations. Heat shrinkable joints shall be made.

Cables shall be terminated onto the terminals of switchgear through crimping lugs of proper size and of heavy duty. Cable lugs shall be fitted onto the cable by crimping or compression jointing.
Continuity of cable armouring is to be maintained. Double compression glands to be used. Proper crimping tools to be used.

1.6 TRENCHING & CABLE LAYING

The minimum width of trench shall be 45 cm and depth shall be 75cm for laying of cable. Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that the minimum gap between the cables is one diameter of the cable unless specified otherwise.

The clearance between axis of the end cables and the sides of the trench shall be minimum 1.5 D (diameter) of the end cable.

The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided.

Where gradients and changes in depth are unavoidable, these shall be gradual.
The bottom of the trenches shall be level and free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 9 cm in depth.

Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less than 20 cms. above the base cushion of sand before the protective cover is laid.

In the case of vertical multi-tier formation, after the first cable has been laid, a sand cushion of 30 cms shall be provided over the initial bed before second tier is laid. If additional tiers are formed, each of the subsequent tiers shall have a sand cushion of 30 cms as stated above. The top-most cable shall have final sand covering not less than 17 cms before the protective cover is laid.

Unless otherwise specified, the cables shall be protected by second class bricks of not less than 20 cm x 10 cm x 10 cm (nominal size) as per CPWD building specification, or protection covers placed on top of the sand, (brick to be laid breadth wise) for the full length of the cable to satisfaction of the owner. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5 cm over the sides of and cables.

The trenches shall be then back filled with excavated earth free from stone or other sharpedged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm. Unless otherwise specified, a crown of earth not less than 50 mm in the center and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of earth, however, should not exceed 10 cms.

Where road bends or lawns have been cut or kerb stones displaced, the same shall be repaired to the satisfaction of the architect and all surplus earth or rock removed to places as specified.

In locations such as road crossing, entry to building in paved areas etc. cables shall be laid in pipes or closed ducts.

All cable entry/exit points into the building through pipe sleeves shall be properly sealed with water and fire safe sealants in an approved manner to avoid any seepage of water into the building.

Manholes of adequate size, as decided by the Architect, shall be provided to facilitate of adequate strength feeding/drawing in of cables and to provide working space for persons. Suitable manhole covers with frame of proper design shall cover Manholes.

CABLE LOOPS: Sufficient cable loop length shall be left at both ends.

1.7 CABLES ON HANGERS OR RACKS / TRAYS

The contractor shall provide and install all iron hangers' racks, or racks with die-cast cleat, with fixing rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides ceiling and other concrete structures, the contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good the damages as required.

The hangers or racks shall be designed to leave at least 25 mm clearance between the cables and the face to which it fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 500 mm intervals. These shall be designed to keep provision of some spare capacity for future development. Minimum spacing between the cables shall be one diameter of the cable or as specified.

1.8 CABLE TRAY

a. Cable trays shall be hot dip galvanized as called for in the schedule of quantities.
b. Cable trays shall be complete with bends, joints, coupler plates and accessories as may be required for joining the cable trays.
c. Cable trays shall be either perforated or ladder type as called for in the schedule of quantities.

1.9 PERFORATED CABLE TRAYS

Standard Technical details of perforated cable tray shall be as follows:

S.	SIZE OF TRAY (Width)	THICKNESS & COLLAR HEIGHT
1.	n to 450mm width	hick & 50mm collar
2.	n to 750mm width	hick & 50mm collar
3.	n to 1200mm width	hick & 50mm collar

Note: Supports shall not be charged extra. It shall be considered to be included in the rate of the tray.

1.10 LADDER TYPE CABLE TRAYS

Standard technical details of ladder type cable trays shall be as follows:

SIZE OF TRAY	SIZE OF MAIN CHANNEL OR RUNNER	SIZE OF RUNG & SPACING	CABLE TRAY SUPPORT
900mm to 1500mm	25 x 100 x 25 x 2.5mm	20 x 50 x 20 x 2.5mm @ 250 C/C	50 x 50x 5mm angle @ 1000mm spacing.
450mm to 750mm	20 x 75 x 20 x 2.0mm	20 x 50 x 20 x 2mm @ 250 C/C	40 x 40 x 5mm angle @ 1250mm spacing.
150mm to 300mm	20 x 75 x 20 x 2.0mm	15 x 35 x 15 x 2mm @ 250 C/C	40 x 40 x 3mm angle @ 1500mm spacing.

Hangers shall be minimum 10mm dia GI Round bar.

Fixing /supporting arrangement shall be as approved by the Consultant / Owner / PMC

Hardware to be used in cable tray system shall be Hot Dip galvanized or zinc passivated.

Note: Supports shall not be charged extra. It shall be considered to be included in the rate of the tray. All structural steel shall be according to the latest revision of IS: 226 & 808.

a. Quality of Zinc

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS: 209-1992.

b. Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square meter shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs; rust stains bulky white deposits, blisters.
Mild steel flats / wires shall undergo a process of degreasing, pickling in acid, cold rinsing and then galvanizing.

1.11 TESTING OF CABLES

The Megger value in normal dry weather shall be 50 mega ohms for 1.1 KV grade cable. Cables shall be tested at works for the following tests before being dispatched to site by the project team:

a. Insulation Resistance Test.

b. Continuity resistance test.
c. Sheathing continuity test.
d. Earth test. (in armoured cables)
e. Hi Pot Test.

Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Owner's site representative:

a. Insulation Resistance Test (Sectional and overall)
b. Continuity resistance test.
c. Sheathing continuity test.
d. Earth test.

All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the PMC / Owner representative.

1.12 CABLE AGS

Cable tags shall be made out of 2mm thick aluminum sheets. Each tag shall be 2" in dia or 3" x 3" square with one hole of 2.5mm dia, 6 mm below the periphery, or as approved by Consultant. Cable designations are to be punched with letters / number punches and the tags are to be tied to cables with piano wires of approve quality & size. Tags shall be tied inside the panels beyond the glanding as well as above the glands at cable entries. Along trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 meters.

Cables shall be secured to cable trays with 3mm thick x 25mm wide aluminum strips/suitable GI clamp, or as approved by Consultant, at 1000 mm intervals and screwed by means of rust proof screws, washers and bolts, of adequate but not excessive lengths. Cable trays for horizontal runs suspended from the ceiling will be supported with mild steel straps or brackets, at 1000 mm intervals and the overall tray arrangement shall be of a rigid construction. External cabling route marker with GI plate marked with "DANGER 1.1 kV CABLE" with 1-meter long GI angle iron grouting bracket including 1:3:6 ratio cement concrete base block of minimum size 200 x 200 x 350 mm to be provided or as approved by Elect. Supply Company.

ANNEXURE - I

SPECIFICATIONS FOR PAINTING WORK

1. Cleaning the surface
2. Apply a primer coat of Red Oxide
3. Applying tow coats of enamel paint of APPROVED colour code after applying cement primer for plastered surface.
4. Standard colour code.

a) Compressor, Condenser, Belt-guards, Pump sets : Battleship Grey.
b) Motor : Siemens Grey
c) Chiller : Dark Blue
d) Air Handling Units : Mulshell Grey
e) Pot Strainers (Base) : Grey
f) Hot Gas Line : PO Red
g) Liquid line : Orange
h) Suction Line : Green/Blue
i) B.M. Valve/Copper Line : Golden Paint
j) Gauge panel : Siemens Grey
k) Chilled Water Line Inlet line (Hot) : Dark Blue
Outlet line (Cold) : Light Blue l) All supports /stands : Black
m) Gas Equalizer Line : Yellow Oil Equalizer Line : Dark Brown n)
Ducting
Concealed : Black Rust Proof
Exposed to Grilles insulated/uninsulated duct : Black
Exposed : Fiesta Blue
Electric Panels : Steel Grey

The colour of the chiller package supplied by the vendor may be accepted.

MODE OF MEASUREMENT

All painting works shall form part of the cost equipment, piping etc. No separate payment shall be advisable.

ANNEXURE - II

I. S. CODES

Following IS CODES will be applicable for the project.

1. IS : 655 – 1963 : Ducting work.
2. IS : 659 - 1964 : Safety Code for Air-conditioning.
3. IS : 660 - 1963 : Safety Code for Mechanical Ref.
4. IS : 5111-1969 : Code of Practice & Measurement Procedure for Testing Refrigerant compressors.
5. IS : 325-1970 : Specifications for 3 Ph. Induction Motor.
   Also confirm to IS : 1231 : Foot Mounted motors.
   and IS : 2223 : flange mounted motors.
6. IS : 2147-1962 : Degree of protection provided by enclosures for low voltage switch gears and control gears.
7. IS : 3012-1965 : Code of Practice for installation (PART-I) maintenance of switch gear.
8. IS : 3061-1982 : Code of Practice for Fire precautions in welding & cutting operations.
9. IS : 3651-1967 : Glossary of terms used in Refrigeration & Air-conditioning.
10. IS STD. for Insulation work

a. IS : 4671-1984 : Expanded polystyrene For Thermal Insulation purposes

b. IS : 661-1974 : Code of Practice for Thermal Insulation of Cold Storages.

c. IS : 7240-1981 : Code of Practice for Application & finishing of Thermal Insulation material at Temp. from 80°C to 40°C.

d. IS : 7413-1981 : Code of Practice for Application & finishing of Thermal Insulation material at Temp. from 40°C to 700°c.

e. IS : 8183 - 1976 : Specifications for Bonded Mineral Wool.

11. IS : 1239 : Pipes up to 150 MM Dia.
12. IS : 3589 : Pipes above 200 MM Dia.
13. IS : 780/ISI Certificates : Valves of PN 1.6 rating
14. IS : 5312 / ISI Certificate : Check Valves
15. IS : 277 : For Sheet galvanising spec.
16. IS : 900 : Installation of motor
17. IS : 4064 & 4047 : Switch fuse unit.
18. IS : 2516 : ACB
19. Relevant ISS : MCCB
20. IS : 3043 - 1963 : Earthing
21. IS : 3043 : Earth Station.

22. IS : 732 - 1963 : Testing of Electrical Installation
23. IS : 520 : Standard for positive displacement Refrigeration, compressor & condensing unit
24. IS : 2825 : Unfired pressure vessels
25. IS : 4503 : Shell & Tube type Heat Exchanger
26. IS : 1520 : Horizontal Centrifugal Pumps for Chiller, Cold, Fresh Water
27. IS : 737 : Specification for Wrought al. & al. Sheet & strip
28. IS : 3069 : Glossary of items symbols & units relating to thermal materials
29. IS : 702 : Industrial bitumen
30. IS : 8183 : Rounded Mineral Wool

NOISE CONTROL

SCOPE

The scope of this section comprises of the supply, installation, testing & commissioning of noise & vibration control equipment & accessories.

STANDARDS

The testing of all noise control equipment & the methods used in measuring the noise rating of air conditioning plant & equipment shall be in accordance with the relevant sections of the following British Standards, unless otherwise stated :

BS 4718: 1971 : Methods of Test of Silencers for Air Distribution Systems

BS 2750: Parts 1-9: 1980 : Laboratory & Field Measurement of Airborne Sound Insulation of Various Building Elements. Recommendations for Field Laboratory Measurement of Airborne & Impact Sound Transmission in Buildings.

BS 3638: 1987 : Methods of Measurement of Sound Adsorption in a Reverberation Room.

BS 4773: Part 2: 1976 : Acoustic Testing.

BS 4856: Part 2:1976 : Acoustic performance without additional ducting of forced fan convection equipment.

BS 4856: Part 5: 1976 : Acoustic performance with additional ducting of forced fan convection equipment.

BS 4857: Part 2: 1978(1983) : Acoustic Testing & Rating of High Pressure Terminal Reheat Units.

BS 4954: Part 2:1978(1987) : Acoustic Testing & Rating of Induction Units.

BS 5643 : 1984 : Glossary of Refrigeration, Heating, Ventilating and Air Conditioning Terms.

GENERAL

Mechanical services shall generally be designed & installed with provisions to contain noise & the transmission of vibration, generated by moving plant & equipment at source where illustrated on the tender drawings & plant & equipment schedules to achieve acceptable noise rating specified for occupied areas.

In addition to the provisions specified in the Specification, particular attention must be given to the following details at time of ordering plant & equipment & their installation :-

a. All moving plant , machinery & apparatus shall be statically & dynamically balanced at manufacturers works & certificates issued.
b. The isolation of moving plant, machinery & apparatus including lines equipment from the building structure.
c. Where duct work & pipe work services pass through walls, floors & ceilings, or where supported shall be surrounded with a resilient acoustic absorbing material to prevent contact with the structure & minimize the outbreak of noise from plant rooms.
d. The reduction of noise breakout from plant rooms & the selection of externally equipment & plant to meet ambient noise level requirements of the Specifications.

e. Electrical conduits & connections to all moving plant & equipment shall be carried out in flexible conduit & cables to prevent the transmission of vibration to the structure & nullify the provisions of anti-vibration mountings.

f. All duct connections to fans shall incorporate flexible connections, except in cases where these are fitted integral within air handling units. Duct work connections to the fan inlets / outlets shall be concentricity aligned so that the flexible connections are not subjected to any strain & not used as a means of correcting bas misalignment.

g. All resilient acoustic absorbing materials shall be non-flammable, vermin & rot proof & shall not tend to break up or compress sufficiently to transmit vibration or noise from the equipment to the structure.

h. Where practicable, silencers shall be built into walls & floors to prevent the flanking of noise the duct work systems & their penetrations sealed in the manner previously described. Where this is not feasible, the exposed surface of the duct work between the silencer & the wall subjected to noise infiltration shall be acoustically clad as specified.

SILENCERS

At tender stage all silencers as scheduled in the specification or on tender drawings will be selected based on preliminary sound power levels obtained from fan/air handling unit manufacturers or fan duties to achieve a noise rating in the occupied space as specified in "Basis of Design" All plant attenuators shall be selected to maintain noise criteria given in this Specification. Attenuators shall be constructed from high quality pre-galvanized steel sheet casings with lock formed joints along the casing length. Angle iron cross jointing flanges shall be fitted to silencer casings, drilled as required & finished with red oxide primer paint.

Acoustic splitters shall be formed by chancel section pre-galvanized sheet steel framework retaining acoustic fill of a density to attain the required performance. Splitters shall have round nose ends to give smooth entry & exit conditions to minimize air pressure drops.

The acoustic fill shall be protected from the air flow by 22 swg minimum perforated galvanized sheet steel.

All silencers shall be selected against a maximum allowable air pressure drop of 75 a.

It will be the responsibility of the Contractor at the time of placing orders for fan equipment to obtain from the manufacturers, certified sound power levels to enable the selected duct silencers to be checked against the original design information, prior to orders being placed.

ANTI-VIBRATION MOUNTINGS

All items of rotating & reciprocating plant & equipment shall be isolated from the structure by the use of anti-vibration materials, mountings or spring loaded supports fixed to either concrete bases, inertia blocks or support steels as indicated.

Centrifugal fans & motors within air handling units shall be isolated from the frame of the air handling unit by suitable anti-vibration mountings. Fan discharge air connections shall be fitted with approved flexible connections internally isolating the fan scroll from the air handling unit casing.

Axial flow fans shall be mounted on steel legs as diaphragm plates supported on neoprene in shear anti-vibration mountings, or suspended using spring loaded hangers to suite the application. Centrifugal pumps shall be mounted on inertia bases consisting of reinforced concrete subbase, anti-vibration mountings & concrete filled steel upper plinth. The Contractor shall be responsible for issuing the steel upper plinth & mountings to the Contractor for building-in.

Pipe work connections to circulating pumps, chillers, cooler coils & other equipment shall be made with flexible connections as per Specifications.

The construction of anti-vibration mountings shall generally comply with following : -

a. ENCLOSED SPRING MOUNTING (CAGED OR RESTRAINED SPRINGS)

Each mounting shall consist of cast or fabricated telescopic top & bottom housing enclosing one or more helical steel springs as the principle isolation elements, & shall incorporate a built- in levelling device.

The springs shall have an outside diameter of not less than 75% of the operating height, & be selected to have at least 50% overload capacity before becoming coil bound.

The bottom plate of each mounting shall have bonded to it a neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

Mountings incorporating snubbers of restraining devices shall be designed so that the snubbing damping or restraining mechanism, is capable f being adjusted to have no significant effect during the normal running of the isolated machine.

Restrained isolator shall be provided on chillers subject to approval by the manufacturers.

b. OPEN SPRING MOUNTINGS.

Each mounting shall consist of one or more helical steel springs as the principal isolation elements, & shall incorporate a built-in levelling device. The spring shall be fixed or otherwise securely located to cast or fabricated top & bottom plates, & shall have an outside diameter of not less than 75% of the operating height, & shall be selected to have at least 50% overload capacity before becoming coil-bound.

The bottom plate shall have bonded to it a neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

c. NEOPRENE-IN-SHEAR MOUNTINGS.

Each mounting shall consist of a steel top plate & base plate completely embedded in oil resistant neoprene. Each mounting shall be capable of being fitted with a levelling device, & bolt holes in the base plate & tapped holes in the top plate so that they may be bolted to the floor & equipment where required.

d. INERTIA BASES FOR PUMPS.

The inertia base shall be an all welded mild steel channel frame the minimum depth of which shall be 1/12 of the longest span between isolator but not less than 150 mm. filled with concrete the density of which shall be 2300 kg/m3.

The inertia base shall be sufficiently large to provide support for all parts of the equipment, including any component which overhands the equipment base, such as suction & discharge elbows on centrifugal pumps.

The frame shall include pre-located equipment anchor bolts fixed into position & housed in a steel sleeve allowing minor bolt location adjustment.

Isolator support brackets shall be welded into the corners of the base & suitably re-enforced for the load of the equipment & base.

Additional reinforcing roads shall be provided at 200 mm. centres to ensure the concrete & frame is adequately stiffened against distortion.

e. FLEXIBLE CONNECTIONS

Flexible connections shall be provided on all duct work connections to fans, rotating plant & equipment isolated from structure & anti-vibration materials or mountings. Pipe work & duct

work crossing building movement or construction joints shall be installed with flexible connections.

Flexible connections on duct work to fans etc. shall be a minimum / maximum free length of 100 mm. / 200 mm. respectively to minimize noise transmission & noise breakout. They shall be completely free from stress & shall not be required to accept any weight.

Thickness & strength of flexible connection materials shall be suitable to withstand the positive & negative fan pressures to which they will be subjected to & shall not allow perceptible leakage. The materials shall be durable, non flammable having food acoustical quality.

Flexible connections shall be fitted to all pump suction & discharge connections, chillers & other vibrating equipment & where anti-vibration mounts & inertia basis are fitted.

Flexible connections shall be fitted to all cooler coil chilled water pipe work connections.

Flexible connections shall allow freedom of movement of plant in all plans.

Making flanges to pipe work flexible connections shall be of the smooth faced weld-nick type.

Rubber Bellows shall be fitted as close to the source of vibration at practicable. The pipe at the other end of the bellows shall be a fixed point.

Rubber bellows shall be single convolution of multiply reinforced EPDM rubber with wire reinforced cuffs. Flanges shall be able to swivel & be removable. The date of manufacture shall be moulded on the bellows. For traceability membranes shall have an indelible identification showing manufacturer, country of origin, the type & a batch number.Tie bars with rubber top hat washers shall be used on bellows.

For working temperatures up to 70o C the rubber bellows shall be high tensile synthetic fibre reinforced.

For working temperature between 70oC & 100oC the bellows carcase shall be steel wire mesh reinforced throughout. Steel reinforced bellows shall be manufactured & approved to the Standards.

For temperatures above 100oC bellow shall be multiply stainless steel with Van Stone ends swivel flanges. The overall length shall not exceed 130 mm.

Flexible connections with screwed connections shall be reinforced EPDM rubber hoses & shall have at least one full union to avoid torquing on installation.

Flexible pipe connections on chilled water systems shall be suitable for a working pressure of 10 bar & test pressure of 17 bar.

ANNEXURE - III

1.0 TESTING OF AIR CONDITIONING SYSTEM

1.1 Routine & types tests for various items of equipment shall be performed at the contractor's work & the test certificates furnished. Functional test shall be conducted at site.

1.2 The performance test to determine whether OR not the full indent of the specification is met shall be conducted by the contractor. After notification to the Employer's that the installation has been completed & the plant has run continuously for a period of at least two weeks, the contractor shall conduct under the direction of the Consultant's & in the presence of Employer's representatives test, such test as specified to establish the capacity of various equipment supplied & installed by the contractor.

1.3 The contractor shall operate test & adjust the air conditioning system units, fans, motors, all air conditioning appliances including adjustment of regulators, dampers etc.

1.4 All test equipment, labour, operating personnel, oil & refrigerant required for this test shall be furnished by the contractor to enable the plant to be put in continuous running test for a period of 3 days after all other tests & adjustments have been made.

The contractor will be provided with electrical power water for testing by the client. The performance test shall be conducted during peak summer & peak monsoon.

2.0 PROCEDURE

2.1 DESIGN CONDITIONS :

The inside & outside conditions will be recorded for 48 hrs. (2 days) duration on hourly basis. The outside & inside Dry Bulb & Wet Bulb temperatures shall be recorded by the means of a sling psychrometer with mercury thermometers. The relative humidity shall be computed from the psychrometeric chart. The inside Dry Bulb temp. & relative humidity shall fall within the specified limits.

2.2 CAPACITY OF THE PLANT :

The following aspects shall be checked before conducting the performance tests :

a. The outside conditions shall be as close to the design values as possible. The tests shall be arranged during the peak summer & monsoon.
b. The internal loads of various spaces shall be close to the design values as far as possible.
c. The plant shall be fully loaded & the temperatures stabilized.
d. Hourly readings of water flow shall be recorded by a calibrated flow meter.
e. Hourly readings of pressure, temperature, electrical current, voltage & power factor shall be properly recorded.

The capacity of the plant & various other equipment & accessories shall be ascertained as follows.

2.3 COOLING COIL OF AHU'S & FCU'S :

The flow of air over the cooling coil will be measured by recording the velocity of air across each filter placed before the cooling coil. The velocity shall be measured by means of end

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anemometer Air quantity across the filters = velocity of air across the filters in FPM x net filter area (in sq. ft.).

The wet bulb temperature of air entering the coil & that leaving the coil shall be measured. The enthalpy of entering & leaving air shall be noted from the psychrometeric chart, corresponding to the wet bulb temp. recorded.

SAY, he - Enthalpy of Entering Air in Btu
/lb H1 - Enthalpy of Leaving Air in Btu / lb.

Ve - Specific Volume of Entering Air (CFT. / lb. of air)

V1 - Specific volume of Leaving Air (CFT. / lb. of air)

Average specific volume = (Ve + V1) / 2 = v (CFT/ lb of air)

Cap. Of cooling coil = (CFM x 60) / v x (He - H1) /1200

(CFM x {He -H1} x 4.5 / 12000)

i) Heat rejection by the condenser (HR in BTU/HR.) = Water flow through the Condenser in lb/hr.x (Temperature difference in Deg.F)

2.4 COMPRESSOR :

The following readings shall be recorded :

i. Suction gas pressure
ii. Discharge gas pressure
iii. Suction gas temperature. iv. Discharge gas temperature.
v. Readings of Ammeter, voltmeter & power factor meter.

Same pressure gauge shall be used for different pressure measurements & the same thermometers shall be used for different temperature measurements. The capacity of the compressor shall be computed from the performance chart supplied by the manufacturer.

IKW / Ton of compressor = (Power in put in KW)

Compressor Cap. in Tons.

2.5 AIR BALANCING :

After the desired inside conditions are achieved, the quantity of air through every outlet shall be measured. Air quantity in CFM = Air velocity at the outlet in FPM x effective area of the outlet in Sq. Ft.

2.6 TESTING OF VARIOUS LOADING CONDITIONS :

The performance test shall be conducted for various loads such as 100%, 75%, 50% of the capacity of the plant, if feasible.

3.0 FUNCTIONAL TESTS :

3.1 ELECTRICAL EQUIPMENT :

i. Cables :

All the cables shall be tested for continuity & absence of cross phasing. Insulation resistance between the phase conductors & earth shall be measured with the help of a 500 V megger,

ii. Motors :

a. Insulation resistance of all motors shall be tested with a megger & the value shall not be less than 1 Meg-Ohms. If observed value is less than 1 Meg-Ohms, the voltmeter winding shall be tried out & winding shall be given a coat of approved insulating varnish.
b. Starting current shall be recorded every time the motor is started.
c. Starter operation shall be checked for a single phasing by removing one of phase.
d. Over load protection shall be checked by altering starter thermal over load setting.

3.2 SAFETY DEVICES & CONTROLS :

i. Interlocks for compressor motor with that of chilled water pumps, condenser water pumps & cooling tower fan shall be checked.
ii. Flow switches in the chilled water lines shall be throttling the valves.
iii. High pressure stat - shall be checked by varying the Settings of the cutout. iv. Low pressure stat - shall be tested by closing the pilot solenoid valve.
v. Anti-freeze thermostat shall be tested by varying the settings.
vi. Oil failure switch shall be tested by varying the settings.

3.3 CAPACITY CONTROLS :

The capacity control arrangement shall be tested by varying the load on the plant. Any other procedure recommended by the manufactures may be adopted with the prior permission of the Employers & Consultants.

4.0 TEST READINGS :

4.1 The following reading shall be recorded hourly during the tests & capacity of the plant shall be computed.

i. Compressor :

1) Suction pressure - Kg/Cm2 (PSI)
2) Suction Temperature - °C (°F)
3) Discharge pressure - Kg/Cm2 (PSI)
4) Condensing Temperature - °C (°F)
5) Oil Pressure - Kg/Cm2 (PSI)
6) Compressor Speed - RPM
7) Motor
   a. Rated Capacity - HP
   b. Rated Volts - Volts
   c. Rated Current - Amps
   d. Starting Current - Amps
8) Power Consumption for
   - 100%
   - 75%
   - 50% loads

   a. Motor current in amps
   b. Voltage
   c. Starting Current

ii. Condenser :

1) Refrigerator condensing Pressure - Kg/Cm2 (PSI)

2) Refrigerator condensing Temperature - “C (“F)
3) Water flow rate - (GPM)
4) Entering Water Temp. - □C (□F)
5) Leaving Water Temp. - □C (□F)
6) Pressure drop through Condenser - Kg/Cm2 (PSI)

iii. Chiller :

1) Refrigerator evaporating pressure - Kg/Cm2 (PSI)
2) Refrigerator evaporating Temperature - °C (°F)
3) Water Flow Rate - Ltr. Sec. (GPM)
4) Entering Water Temp - °C (°F)
5) Leaving Water Temp. - °C (°F)
6) Pressure drop through Chiller - Kg/Cm2 (PSI)

iv. Air Handling Units & Fan Coil Units :

1) Air velocity - M/Hr. (FPM)
2) Coil Face Area - M²(SFT)
3) Air Quantity - Cu. M/Hr. (CFM)
4) Entering Air Temp. DB. - °C (°F)
5) Entering Air Temp. WB. - °C (°F)
6) Leaving Air Temp. DB. - °C (°F)
7) Leaving Air Temp WB. - °C (°F)
8) Entering Water Temp - °C (°F)
9) Leaving Water Temp - °C (°F)
10) Entering Water Pressure - Kg/Cm2 (PSI)
11) Leaving Water Pressure - Kg/Cm2 (PSI)
12) Motor
    a. Rated Horse Power - HP
    b. Rated volts - volts
    c. Rated Current - Amps
    d. Actual Current - Amps
    e. Actual volts - Volts
    f. Actual Current - Amps
    g. Starting Current - Amps

v. Pumps :

1) Flow Rate - Ltr/ Sec (GPM)
2) Discharge Pressure - Kg/Cm2 (PSI)
3) Section Pressure - Kg/Cm2 (PSI)
4) Motor
    a. Rated Horse Power - HP
    b. Rated Current - Amps
    c. Rated volts - Volts
    d. Actual Current - Amps
    e. Starting Current - Amps

vi. Supply Air Grilles :

1) Area of Grill - M² (SFT)
2) Velocity - M/HR. (FPM)
3) Air Flow Rate - M² (FPM)
4) Temperature DB - °C (°F)
5) Temperature WB - °C (°F)

vii. Filters

1) Total Area - M² (SFT)
2) Effective Area - M² (SFT) /M/ Hr.
3) Velocity of Air - M/Hr (FPM)
4) Quantity of Air - M3 /Hr. (CFM)

viii. Controls, Interlocks etc. :

The observations of the test shall be recorded for each item separately.

NOTE :

All caliberated intruments with calibration certificate will be arranged by contractor for measurement purpose.

ANNEXURE - IV

1.0 MODE OF MEASUREMENT :

The following measurement code shall apply to this contract :-

1.1 FOR CHILLER :

The entire water chilling package with all accessories, Starters, Controls, Control Panel, Control Wiring, Refrigerant charge, Oil etc., Erection, Commissioning & Testing shall be regarded as one unit for purpose of measurement.

1.2 FOR CHILLER PUMPS :

The pump together with the Coupling, Coupling Guards, Base Plate, Vibration mounts in the Thermal Insulation, Erection, testing, & commissioning will be one unit of measurement. Motor for chiller & condenser pumps shall be measured as one unit.

1.3 FOR AHU :

AHU with filters, fan & coil section, without motor, with base frame motor, drive & guard suitable for motor, mounting frame, vibration mounts as specified in BOQ shall from one unit of measurement.

Each Motor of AHUs shall be considered one unit of measurement.

Installation, testing & commissioning is a part of above points.

2.0 SHEET METAL WORK :

2.1 DUCTING :

a. All sheet metal ducting work will be measured in terms of final sheet area installed in Sq. meters.
b. No measurement of vanes, splitters, duct, dampers deflectors, access doors etc. which are required to be installed in the duct work will be made as the same shall be deemed to be part of ducting work.

2.2 GRILLES :

All grilles will be measured in in running lengths (meters) for different sizes.

2.3 DIFFUSERS :

Diffusers will be measured in terms of nos. for different sizes.

2.4 DAMPERS :

a. All duct dampers shall be measured separately in terms of effective area.
b. Fire dampers will be measured in terms of effective area in Sq. metes.
c. Fresh air / exhaust air dampers will be measured as (II) above. No separate measurement will be made for inlet/ outlet louvers, bird screen etc.

Example : 24” x 4” will be measured as 0.667 FT^2.

3.0 PIPING :

a. Piping will be measured in running lengths (meters)

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b. No special measurement of bends, elbows, reducer, expanders, tees, cross etc. will be made. All such fittings/ accessories will be treated as normal piping.
c. The length of the piping including accessories & fittings will be measured along the enter line of piping.
d. No measurement for flange shall be made. All flanges shall form the part of the piping work.
e. No measurement of pipe supports, hangers, spring isolator, anchors, etc. will be made. All such items shall be deemed to form part of piping work.
f. No measurement will be made for sockets for thermometers & pressure gauges.

4.0 INSULATION :

4.1 DUCTING INSULATION :

a. Duct insulation will be measured on the basis of Inner line of insulation & not the outer line of insulation.

Example : (Perimeter) x 1 meter length.

b. No special measurement shall be made for insulation of bends, transformation pieces, tap offs, elbows, etc. All such insulation shall be treated as standard duct insulation
c. Insulation items shall include all accessories & finishes as specified. No separate measurement will be made for such items.
d. Duct fittings such as bends, elbows tap offs, collars, transformation pieces etc. shall be treated as ordinary duct pieces with their length measured along their center line.
e. No duct support, stiffening, member etc. shall be measured separately. All such supports/ hangers shall form part of the duct work.
f. Equipment connections such as canvas/ rein shall be deemed to be part of the duct work & no separate measurement will be allowed.

4.2 PIPING INSULATION :

a. All piping insulation shall be in linear measure along the inner line of the pipe & rounded off to the nearest centimeter, over all fittings excluding flanges & valves.
b. No separate measurement of insulation shall be made for fittings such as bends, elbows, reduces, expanders, tees, crosses, flanges, etc. All such insulation shall be linear in meters measurement along the center line of piping.
c. All accessories & finishes connected with the insulation work shall be deemed to form part of insulation & no separate measurement will be made for such items.

Insulation of valves will be measured as a unit for particular size of valve.

Example : 50 mm dia valve insulation (25 mm thick) 1 No.

4.3 EQUIPMENT INSULATION :

No measurement for insulation of any equipment will be made. Insulation of equipment shall be deemed to form part of the equipment.

5.0 ELECTRICAL WORK :

a. All cables shall be measured in running lengths as finally installed at site. No wastage measurement will be allowed.

b. Control cable /wiring for a plant inside the plant room shall be treated as a lump sum item.

c. All measuring instruments, indicating lamps etc. shall form part of the equipment specified and no separate measurement shall be made for such items.

A. LT CABLES (1.1 KV GRADE)

i. TESTS & INSPECTION

The Megger value in normal dry weather shall be 50 mega ohm for 1.1 KV grade cable. Cables shall be tested at works for the following tests before being dispatched to site by the project team:

a) Insulation Resistance Test.
b) Continuity resistance test.
c) Sheathing continuity test.
d) Earth test.(in armoured cables)
e) Hi Pot Test.

Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Owner's site representative:

a) Insulation Resistance Test(Sectional and overall)
b) Continuity resistance test.
c) Sheathing continuity test.
d) Earth test.

All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the PMC / Owner representative.

B. CHILLERS

i. CODES & STANDARDS:

a) AHRI 550/590 or EUROVENT
b) ANSI / CE PED Directive

Tests to be carried out along the all productive process as imposed by ISO9001. Possibility to have performance and acoustical witness tests, with the support of qualified technical operators. Performance tests should measure electric data, water flows, operating temperature, absorbed and given power, both at full load and partial load condition. It's should even be possible to have a simulation of the most common alarm states and the pressure drops (water side) measurements.

The acoustical tests should allow verifying level of sound emissions of the unit; tests to be performed on repeating measurements of sound pressure in determined points, positioned on an ideal grid with walls 1 meter distance from the unit panels. For every measuring point a spectrum in octave band for sound pressure and the average value to be reported to the customer. The average global values for pressure at 1 meter, according to ISO3744, and the average sound power referred to the whole unit, to be counted.

ii. FACTORY TESTING

B) CAPACITY& EFFICIENCY:

One Chiller shall be tested for performance at Manufacturer works at 100% & 25% at AHRI condition and at 75% and 50% at Design condition (at constant condenser entering temperature) for verification of IKW/TR & Capacity as per submission of AHRI selection data sheet. If the inspection is outside India, the contractor shall visit and witness the test and shall submit photographs/proof to ascertain his witnessing the testing. The Client / Consultant representative (5 PAX) may also witness the test. The cost of their visit shall be borne by the Client. However, necessary coordination shall be arranged by the Contractor for their visit. In case of failure of any equipment during testing, the Contractor shall be bound to arrange for subsequent inspections. All the expenses (including travel, boarding etc.) for such inspections shall be borne entirely by the Contractor.

C. PUMPS

i. TESTS & INSPECTION

Pump performance shall be computed from the pump curves provided by manufacturer. All pumps shall be tested at factory as per relevant BIS codes. Routine and type test certificates shall be furnished for the pumps. A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the maximum discharge head or twice the rated discharge head., whichever is higher. While arriving at the above pressure, the maximum suction head shall be taken into account. The hydrostatic tests on the casing shall be conducted for a minimum duration of 30 minutes.

ii. PERFORMANCE TEST

(c) Standard Running Test

The pumps shall be tested as per IS 5120, at rated speed at SUB-CONTRACTOR's works to measure capacity, total head, efficiency and power. The negative tolerance on efficiency shall be limited to 2.5% (not 5 % as indicated in IS 5120. These tests shall form the basis for acceptance of pumps except for vibration and noise. The pumps shall be tested over the range covering from shut-off head to the maximum flow. The duration of the test shall be minimum one hour. Minimum five readings approximately equidistant shall be taken for plotting the performance curves.

(d) NPSH TESTS

NPSH tests shall be conducted with water as the medium.

(e) Mechanical Balancing

In addition to static balancing, impeller and balancing drum shall be balanced dynamically at or near the operating speed.

(f) Field Testing

After installation, the pumps shall be subjected to testing at site also. If the field performance is found not to meet the requirements regarding vibration and noise as specified, the equipment shall be rectified or replaced by the CONTRACTOR, at no extra cost to the EMPLOYER.

D. COOLING TOWERS

Capacity of the cooling tower shall be computed from the measurements of water flow, incoming/outgoing water temperatures and ambient air wet bulb temperature using accurately calibrated mercury-in-glass thermometers. Computed ratings shall conform to the specified

capacities and quoted ratings. Power consumption for cooling towers shall be computed from measurements of incoming voltage and input current.

E. VRF AIRCONDITIONING SYSTEM

i. TESTING

a) Routine and types tests for various items of equipment shall be performed at the contractor's work and the test certificated furnished. Functional test shall be conducted at site.

b) The performance test to determine whether OR not the full indent of the specification is met shall be conducted by the contractor. After notification to the Employers that the installation has been completed and the system has run continuously for a period of at-least two weeks, the contractor shall conduct under the direction of the Consultants & in the presence of Employer's representatives perform such test as specified to establish the capacity of various equipment supplied and installed by the contractor.

c) The contractor shall operate test and adjust the air conditioning system units, fans, motors, all air-conditioning appliances including adjustments of regulators dampers etc.

d) All test equipment, labour, operating personnel required for this test shall be furnished by the contractor to enable the system to be put in continuous running test for a period of 3 days after all other tests and adjustments have been made.

The contractor shall make arrangement of electrical power and water for testing. The performance test shall be conducted during peak summer and peak monsoon.

ii. TEST READINGS

The following readings shall be recorded hourly during the tests and capacity of the plant shall be computed.

a) Compressor

1. Suction pressure – Kg / Cm² (PSI)
2. Suction Temperature – °C / (°F)
3. Discharge pressure – Kg / Cm² (PSI)
4. Discharge Temperature – °C (°F)
5. Oil Pressure – Kg / Cm² (PSI)
6. Compressor Speed – RPM
7. Motor – °C (°F)
   i. Volts – Volts
   ii. Current – Amps iii. Power factor –
8. Power consumption for
   i. 100% Load –
   ii. 75% Load – iii. 50% Load
   –

b) Condenser

1. Refrigerant condensing pressure – Kg / Cm² (PSI)
2. Refrigerant condensing temperature – °C (°F)
3. Water flow rate – Ltr. / Sec (GPM)
4. Entering Water Temp. – °C (°F)
5. Leaving Water Temp. – °C (°F)
6. Pressure drop through condenser – Kg / Cm² (PSI)

c) Indoor Units

1. Air velocity – M/Hr. (FPM)
2. Coil Face Area – M²(SFT)
3. Air Quantity – Cu. M/Hr. (CFM)
4. Entering Air Temp. DB. – °C (°F) 5. Entering Air Temp. WB. – °C (°F) 6. Leaving Air Temp. DB. – °C (°F) 7. Leaving Air Temp WB. – °C (°F)

d) Controls, Interlocks etc.

The observations of the test shall be recorded for each item separately.

F. AIR HANDLING UNITS

i. Factory performance testing to establish the cooling capacity of the unit, air flow rate , dry bulb and wet bulb temperatures of air entering and leaving the coil of the air handling unit using PLC controlled graphical display. All the results must be fully computerized and can be seen on real time basis.

ii. The testing setup shall be in accordance with DIN EN 14511. Minimum 4 hours continuous real time readings should be recorded for computation of operational parameters. Additionally , electrical safety Hi-pod testing , dry run testing for control logic , thermal bridging test and leakage testing of cabinet at works must be complied with as part of performance test of the air handling unit, if Specified in BOQ.

iii. Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury- in-glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

G. DUCTING (Leak Test)

After duct installation, a part of duct section (approximately 5 % of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA - “HVAC Air Duct Leakage Test Manual” (First Edition)

H. AIR DISTRIBUTION SYSTEM

i. TESTING & BALANCING

After the installation of the entire air distribution system is completed in all respects, all ducts shall be tested for air leaks by visual inspection.

The entire air distribution system shall be balanced to supply the air quantities as required in various zones and rooms to maintain the specified room conditions. The final balancing of air quantity through each grille or diffuser shall be recorded and submitted to the Consultant / Employer for approval.

The entire air distribution system shall be balanced using an anemometer. Measured air quantities at fan discharge and at various outlets shall be identical to or less/excess than 5 percent in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted for scrutiny and approval, and four copies of the approved balance report shall be provided with completion documents.

I. PIPING (Pressure Test)

All water piping shall be tested to hydrostatic test pressure of at-least two times the maximum operating pressure, but not less than 10 Kg/cm2 for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Consultant. Piping repaired subsequent to the above pressure shall be retested in the same method as mentioned above.

i. TESTING

a. During construction, the contractor shall properly cap all lines, so as to prevent the entrance of sand, dirt, etc. Each system of piping shall be flushed thoroughly after completion (for the purpose of removing dirt, grit, sand etc. from the piping and fittings) for as long a time as is required to thoroughly clean the system.

b. All piping shall be tested to hydrostatic test pressure of atleast two times the maximum operating pressure, but not less than 10 kg per sq. cm gauge for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified, retested and gotten approved

c. Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

d. Piping may be tested in sections and such sections shall be securely capped, then re-tested for the entire system.

e. The Contractor shall give sufficient notice to all other agencies at site, of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by Owner's site representative.

f. The contractors shall provide temporary pipe connections to initially by-pass condenser/chiller and circulate water through condenser/chilled water pipe lines for minimum 8 hours. Water should be drained out from the lowest point. The temporary lines shall be removed and blanked with dead flanges. Pot strainers and Y strainers shall be cleaned and fresh water filled in the circuits.

g. Contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils & other heat exchange equipment in the system concerned. If proper circulation is not achieved due to air bound connection, Contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications including the tearing up and re-finishing of floors and walls if required.

h. After the piping has been installed, tested and run for atleast three days of eight hours each, all insulated exposed piping in plant room shall be given two finish coats, 3 mils each of approved colour, conforming to relevant BIS Codes. The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows. For painting of insulated and clad pipes refer to Insulation section.

i. After testing, all systems shall be chemically cleaned. After cleaning, the pipe work should be rinsed multiples times until the system is neutral. Before handover Owner's site representative shall be provided with certificate of cleaning of pipe systems, signed by the contractor.

j. The Contractor shall provide all materials, tools, equipment, instruments, services and labour required to perform the test and to remove water resulting from cleaning and after testing.

ii. BALANCING

a. After completion of the installation, all water system shall be adjusted and balanced to deliver the water quantities as specified, quoted, or as directed.

b. All balancing valves, Automatic control valves and two-way diverting valves shall be set for full flow condition during balancing procedure. Each water circuit shall be adjusted thru balancing valves provided for this purpose; these shall be permanently marked after balancing is completed, so that they can be restored to their correct positions, if disturbed.

c. Complete certified balancing report shall be submitted for evaluation and approval by Owner's site representative. Upon approval, four copies of the balancing report shall be submitted with the as-installed drawings and completion documents.

J. FANS

i. PRESSURIZATION FANS

Factory performance test required conforming all rated and duty parameters as per IS 325 standard.

ii. CABINET & INLINE FANS

Capacity of all fans shall be measured by an anemometer. Measured airflow capacities shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current. Contractor has to carry out the field balancing, if required.

K. PANELS & SWITCH BOARDS

i. Physical, Electrical, and Operational tests of all Breakers / Switches.

ii. Operational check of all meters and relays. iii. Dielectric strength test for insulation at 2.5kV for 1 sec.

iv. Insulation resistance test at 1000V megger,

v. Protective measures and continuity of circuits, as per IS: 8623-I, 1993.

vi. Testing of protection relays by secondary injection kit before commissioning. vii. Interlocking Function Test.

viii. Earth continuity test between various Non-current carryings parts of equipment steel work etc. & the earth bus provided in the panel.

ix. Test Certificate Type & Routine

Test results for routine tests conducted at works should be submitted. Type tests as per IS: 8623 - Part I for Short circuit, Temperature rise, Degree of protection to meet the specifications and B.O.Q must be furnished.

APPROVED MAKES LIST :

Sr.	Component	Approved Make
1	Screw Chillers	Climaveneta / Daikin / Dunham Bush / Voltas / Trane
2	Cooling Tower (CTI Approved)	Advance / Mihir / Paharpur
3	Smart Air Handling Unit	VTS / Stulz / Edgetech / Citizen
4	Indoor Units	
a	VRF Units	Daikin / Mitsubishi Electric / Toshiba / Samsung / Blue Star / Voltas / LG / Hitachi
b	Split Units	Blue Star / Daikin / Carrier / LG / Mitsubishi Electric / Samsung / Hitachi
c	PAC Units	Stulz / Vertiv / Climaveneta
5	Filters	AAF / Mechmark / Dyna
6	Fans	
a	Centrifugal Fan	Kruger / Caryaire / Nicotra / Green Heck
b	Inline Fan	Kruger / Caryaire / Nicotra / Green Heck
c	Propeller Fan	GEC / ACCO / Khaitan / Orient / Crompton
d	Axial Fans	Kruger / Caryaire / Nicotra / Green Heck
e	Jet Fans	Kruger / Caryaire / Nicotra / Green Heck
7	Dry Scrubber	Rydair / Espair
8	Duct Work	
a	G.I. Sheets	Sail / Nippon / National / Jindal (JSW)
b	Aluminium sheet	Hindalco / Sail
c	Pre-insulated ducts	Asawa / Zeco / Unigulf
9	Insulation	
a	Fibreglass	FGP / UP Twiga / Khimco
b	Expanded Polystyrene	Beardsell / Cooline
c	Expanded Polyethylene	Nikifoam / Profeel
d	Nitrile rubber	Aeroflex / Armaflex / K-Flex
10	Grilles / Diffusers / Dampers & VAV Boxes	Cosmos / Dynacraft / Caryaire
11	PVC Eliminators / Air Inlet Louvers	Munters / SM Plastics / Approved Eqvt
12	Piping	
a	Copper Piping	Rajco / Mehta / Parasmani
b	Chilled Water Piping	Tata / Jindal / Zenith
c	PVC Piping	Supreme / Prince / Approved Equivalent ISI
13	Duct / Pipe Supporting System	Mupro / Gripple / Walraven
14	Cushy Foot Mounts	Dunlop / Resistoflex / Poly Bond
15	Valves	

a	Butterfly Valve	Advance / Audco / BBVI / Saunders
b	Balancing Valve	Advance / ITT Bell & Gossett / Danfoss / Flowcon / T&A
c	Ball Valve	RB / Cimberio
d	Wafer Swing Check Valve	Advance / Flovel
e	"Y" & Pot Strainer	Advance / Trishul / Leader / L&T
f	Automatic Air Purging Valve	Flamco / Itap
g	Strainers / Gate / Globe Valves	Advance / Trishul / Leader
h	Mixing / 2 OR 3 Way Valves	Belimo / Honeywell / Schneider / Siemens
i	Motorised Valve	Belimo / Honeywell / Schneider / Siemens
j	Motorised Valves For FCU	Belimo / Honeywell / Schneider / Siemens
k	Energy Valves	Belimo
l	PIBCV	Belimo / Siemens
16	Pumps	Grundfos / Xylem / Armstrong
17	Variable Pumping System	Grundfos / Xylem / Armstrong
18	Variable Speed Drives	Danfoss / Hitachi / Yaskawa
19	Closed Expansion Tank	KD Agencies / Xylem / Grundfos
20	Air Separator	KD Agencies / Xylem / Grundfos
21	Motors	Crompton / Bharat Bijlee / NGEF
22	Cables	
a	Power Cables	ICC / CCI / Gloster
b	Control Cables	Finolex / Polycab
c	Signal Cables	Ratron / Associated
23	Controls / Measurement Instruments	
a	Thermometers	H. Guru / Teddington
b	Water Pr. Gauges	H.Guru / Fiebig
c	Solenoid Valves	Sporlan
d	Flare Nuts / Cu. Fittings	Castel / Kim
e	Proportionate Controller	Honeywell / Schneider / JCI
f	Voltmeter / Ammeter	Enercon /A/E – Imp/ Trinity
g	Flow Meters	Honeywell / Schneider / JCI
h	Energy Meter	IME / Ducati / L&T / Enercon / Siemens
i	Pressure Transmitter	Honeywell / Schneider / JCI
j	BTU Meters	Kamstrup / Siemens / Landys + Gyr / Engelmann
24	PAC Units	Stulz / Vertiv / Schneider / Climaveneta
25	Circuit Breakers	Schneider / Merlin Gerin / ABB / English Electric / L&T / C&S
26	Starters	Schneider / L&T / TC

27	Push-Buttons / Overload Relay	Schneider / L&T / C&S / RASS
28	Transducers	
a	Power Transducers	Mecon
b	Frequency Transducer	Enercon / Situ
c	Current Transducer	Enercon / Situ
d	Power Factor Transducer	Enercon / Situ
e	Kilowatt Hour Transducer	Enercon / Situ
f	Voltage Transducer	Enercon / Situ
29	Sensors	
a	CO / CO_2 Sensors	Honeywell / Greystone
b	Immersion Temperature Sensor	Honeywell / Schneider / Greystone
c	Duct Temperature Sensor	Honeywell / Schneider / Greystone
d	Outside Temperature Sensor	Honeywell / Schneider / Greystone
e	Outside Rh. Sensor	Honeywell / Schneider / Greystone
f	Outside Rh / Temp. Sensor	Honeywell / Schneider / Greystone
g	Air Quality Sensors	Honeywell / Schneider / Greystone
h	Ph Sensor	Kele
I	Water Hardness Analyser	Kele
j	Thermostat For FCU	Honeywell / Schneider / JCI
30	Switches	Schneider / L&T / C&S / English Electric
a	Water Flow Switches	Honeywell / Schneider / JCI
b	Differential Pr. Switches	Honeywell / Schneider / JCI
c	Level Switches	Honeywell / Schneider / JCI
31	Computer	IBM / HP / Compaq / Wipro
32	Printer - Inkjet	HP / Epson
33	DDC Controller	Honeywell / Schneider / Siemens / Beckhoff
34	System Integration Units	Honeywell / Schneider / JCI
35	Automatic Tube Cleaning System	HVS / CET Enviro / Ecomax
36	VRF Units	Daikin / Mitsubishi Electric / Toshiba
37	Panels	
a	Readymade panels as per IEC 61439 1& 2	Schneider/ Legrand / L& T / siemens
b	APFC standard capacitors (APP/MD)	Subodhan / Visa / Shreem / PMX / Vishay / L& T/ Neptune
c	ACB	Schneider / Siemens / Legrand / Mitsubishi
d	MCCB	Schneider / ABB / Siemens / Legrand
e	RCCB	Legrand / Schneider / Hager / Siemens / Mitsubishi / Havells
f	MCB	Legrand / Schneider / Hager / Siemens / Indo Asian / Eton / Mitsubishi / Havells

g	MCB DB	Legrand / Schneider / Siemens / Havells
h	Load manger / digital meter	HPL / Secure / Conserve / Elemeasure
i	APFC Relay	Beluk / L&T / Electronicon / Sycon / Shrem
j	Contactor	Siemens / Schneider / Legrand
k	Fuses	Schneider / Siemens / Legrand
l	Push Buttons	L&T / Rass / Teknik / Siemens
m	Pilot Lamps (Indications) LED	Altos / Teknik / Rass / siemens
n	PLC	Allen Bradly / Messung
o	Annunciator	Minilec / Equiv
p	Terminals	Wago / Elmex / Connectwell
q	Relays (protections)	Alsthom / L&T / ABB / Schneider
r	Auxiliary relay	OEN / Equiv
s	Industrial sockets	Legrand
t	Motors	Kirloskar / Crompton / ABB / Siemens
u	Motor starter	L&T / Siemens / Schneider / ABB
v	SPD	Obo Betterman / Phoenix / Emerson / Cape / Omcons
w	Readymade panel (NFPA 70 e base type tested for internal arc.is 61439 ,is 61641	Schneider / ABB / Siemens / Marine
x	**RTPFC** with / without reactor	une / Clariant / Sycon / Power Matrix / Subodhan / Powerfield
y	Meter (Analog)	Rishab / L&T / AE / Secure
z	Sandwich Busduct / Readymade Busbar	Schneider / Siemens. / Zucini / Legrand
aa	UPS	Eton / Socomec / Emerson/ Numeric
ab	CTS' / PT	AE / Kappa / C & S / Newtek
	Cable	
a	AL. / CU. conductor cables XLPE / PVC	Finolex / KEI / RPG / Polycab / RR
b	CU. Conductor unarmoured cables	KEI / RR / LAPP / Finolex / Polycab
c	Heavy Duty Brass cable gland	HMI / BRACO / Jainson / Havells
d	CU. Lugs	Dowell's / Atlas
e	AL. Lugs	Dowell's / Atlas
f	Cable trays & accessories	Elecon / Profab / Indiana/ Legrand / Asia Fab / Electra Fab

ANNUAL MAINTENANCE CONTRACT FOR HVAC

SCOPE OF WORK

1) Maintenance of Air-conditioning System, Chillers and minor and major repairs of the system.
2) Check and service all the equipment's every three months i.e. four times in a year. 3) Attend any numbers of complaint within 3-6 hrs.
4) Checking the functioning of unit.
5) All filter cleaning to be done quarterly.
6) Equipment will be checked for its proper working readjustment if necessary.
7) Replacements of defective / worn-out parts due to normal wear and tears.
8) Checking the gas pressure and refilling if required.
9) Cleaning of drainpipe external to the equipment.
10) The maintenance service is made available even after normal working hours and on holidays.
11) Gas charging of all the air-conditioning system.
12) Leak test of the air-conditioning if required.
13) Repairs of air filters and display kit.
14) Part to be include : Fan motor, Blade, Gas charging, and PCB kit.

EXCLUDING:

Plastic parts, remote control, Compressor, grill, metal ducting, diffusers, welding work, and condensers.

PENALTY

i) As the work involved is quite specialized and continuous monitoring is required. A penalty of Rs.1000/- (Rupees One thousand only) per day will be imposed if the problem related to air-conditioning is not solved within 24 hrs.

Place: Accepted

Date: Signature and Stamp of contractor

TECHNICAL DATA SHEET

(TO BE FILLED IN AND TO BE UPLOADED / SUBMITTED BY THE BIDDER)

With reference to the technical Specifications related to this bidding, we furnish the details of products offered by us fully conforming to the Technical Specifications.

Sl.No.	Item Description	To be filled by the Bidder
1	Make of UPS Conforming to Technical Specifications	
2	Model No. of UPS	
3	Module capacity of UPS	
4	Total No. of Modules	
5	Total capacity of UPS in kW/kVA	
6	No. of racks to mount UPS modules	
7	Warranty period in Years for Modular UPS System	
8	Make of Lithium ion Battery (LiB)	
9	Type of technology / Cell Chemistry of LiB	
9	Total Ah per LiB Module	
10	Total kWh per LiB Module	
11	No. of LiB Modules per rack	
12	No. of LiB Module racks	
13	Total Ah of LiB	
14	Total kWh of LiB (184.21kWh Minimum)	
15	Total back up time at 350 KVA/KW	
16	Warranty period in Years for LiB Modules	

ANNEXURE-A

TEST PARAMETERS& FORMAT

Sl.No.	Parameter	Requirement / Specification	Test Results / Remarks
1	Type of UPS	Modular and Scalable with Hot Swappable Power Modules, Static Switches and control module.	
2	Capacity of UPS	150 kVA	
3	Technology	a. DSP Based True Online Double Conversion with latest and advanced IGBT PWM technology Rectifier & inverter	
		b. Parellel capability upto 10 nos. of Power Modules for vertical redundancy and upto 8 UPS units/modules for capacity	
		c. Redundant System with redundant and hot swappable controller, Redundant and hot swappable Aux Power Supply.	
		d. Dual CAN Bus within frame & Redundant CAN bus between parallel systems to enable UPS to be removed or inserted in parallel configuration without need of transferring it to bypass mode.	
		e. UPS should have feature to enable automatically transferring some modules to sleep mode in case of applied load is less than certain load percentage. Modules would be switched periodically & in rotational manner under this condition.	
		f. UPS should have feature for testing of the unit for load testing without external load.	

 Signature & Seal of Contractor

4	Capacity of Rack for mounting UPS modules	For 150 kVA (2 x 150kVA rack) (Single Input and output will be provided by Bank(SBI), necessary paralleling accessories to be considered by the bidder / UPS vendor)	
5	Capacity range of single UPS module	Min 25 kVA/kW & Max 50 kVA/kW	
6	Nominal Input Voltage	380/400/415 V (user selectable) 3 Phase 4 Wire System / 3 Phase 3 Wire System	
7	Input Voltage Range	320 V AC to 460V AC	
8	Input Frequency Range	50 Hz ± 10% (45 to 55 Hz)	
9	Input Power Factor	0.99 for any load	
10	Input Current Harmonic Distortion (THDi)	≤3 at full load.	
11	Output Voltage	380 /400/415 V user selectable 3 Phase 4 Wire + Ground	
12	Output Voltage Regulation	≤1% Max	
13	Out Put Wave Form	Pure Sine Wave	
14	Output Frequency	50 Hz	
15	Output frequency regulation	±0.05 Hz free running	
16	Output Power factor	Unity	
17	Output Voltage Distortion (THDv)	≤2% for linear load & ≤5% for non linear load.	
18	Output Crest factor	3 : 1	
19	Transient recovery Time	<20 msec	
20	Overload capability	120% for 10 Minutes 150% for 1 Minutes	
21	Efficiency	Minimum 96% at 25 to 100% of load in double conversion mode at input voltage with battery fully charged.	
22	Battery Charger	UPS Inbuilt Battery charger compatible for Lithium Ion Batteries	

23	Input Phase Sequence Correction	Inbuilt feature to be provided for as to avoid UPS transferring to battery mode in case of phase sequence change at input. UPS should continue to work on mains mode.	
24	Automatic & Bi-directional static bypass	The integral bypass shall perform an automatic transfer of the critical load from the inverter to the bypass, in the events of overload , over temperature, or inverter failure conditions with zero transfer time and retransfer from bypass to inverter on removal of overload and fault conditions.	
25	Cable Entry	UPS should have top cable entry	
26	Digital Touch Screen Display for	a.Input AC Voltage, Current & Frequency	
		b.Output AC Voltage, Current & Frequency	
		c.Load (in kVA/kW/Percentage)	
		d. Battery Voltage	
		e. Battery Current	
		f. Event Log to display a log of status and alarm events to be provided on the front panel display	
		g. UPS should have capability to capture wave forms pre & post event occurs.	
27	Inbuilt Protections	a.Over load / Over Current protection	
		b. Short circuit Protection	
		c.Over temperature Protection	
28	Built in Audible Alarms	f. Mains Failure	
		g. Low Battery	
		h. Over Load	
		i. Fault	
		j. On Battery / Bypass	
29	Remote UPS Monitoring Kits	Be able to connect to a LAN network using the main network communication protocols (SNMP or TCP/IP or HTTP)	

30	SNMP card / Web management System	To be provided	
31	Operating Ambient Temperature	0 to 40 degree Celsius	
32	Operating Relative Humidity	<95% Non condesing	
33	Audible Noise level at a distance of one meter from front side of UPS	<80 dB	
34	IP Class	IP 20	
35	Type of cooling	Built in Forced Cooling (multiple fans)	
36	UPS should conform Standards & regulations	d. CE Certification	
		e. Safety EN 62040-1	
		f. EMC EN 62040-2	
37	Auto restart facility	on Mains resumption	
38	Cold Start facility	on battery without mains	
39	Year of manufacture of UPS	2025	
40	LITHIUM ION BATTERIES (LiB)		
	a.Cell Chemistry	NMC (Nickel Manganese Cobalt / LMO (Lithium Manganese Oxide)	
	b.Total Battery back up time	30 Minutes at 150 kVA/ kW	
	c.Total Watt Hour Output (kWh)	Minimum 78.95 kWhr energy required	
	d.Configuration	Single or multiple rack mounted	
	e.Battery Management System (BMS)	To be provided	
	f.Switch Gear	MCCB,MCB, DC Fuse communication ports for module BMS & Rack BMS & System BMS DC IN Ports	
	g.SMPS (Switched Mode Power Supplies)	Dual Type, Input AC, Output-DC to switch gear BMS Ports Communication & Dry Contacts	
	h.Communication	Dry Contacts, Network Protocol	

	i.Software	Licensed BMS Software (Windows 10 or above	
	j.Safety Standards	All safety standards as applicable.	
44	Year of manufacture of LiB	2025	

AMC Terms and Penalties

1. The Bidder/Contractor/Vendor warrants that the Products supplied under the Contract are new, unused, of the most recent or current model and they incorporate all recent improvements in design and / or features. The Bidder/Contractor/Vendor further warrants that all the Products supplied under this Contract shall have no defect, arising from design or from any act of omission of the Vendor that may develop under normal use of the supplied Products in the conditions prevailing in India.

2. Warranty for UPS & Batteries: Onsite comprehensive warranty for the Modular UPS System including free replacement of spares, parts, kits as and when necessary will be 24 months (2 Years) from date of successful installation.

3. Onsite comprehensive warranty for the Lithium-Ion Batteries including free replacement of batteries / cells /spares, parts, kits as and when necessary will be 60 months (Five Years) from date of successful installation.

4. On-site comprehensive warranty and AMC : The warranty and AMC would be on-site and comprehensive in nature and back to back support from the OEM. OEM will warrant all the UPS, Batteries against defects arising out of faulty design, materials and workmanship etc. for the specified warranty period. OEM will provide support for UPS, Batteries and other preinstalled software components during the warranty period. Bidder/Contractor/Vendor shall repair or replace worn out or defective parts including all plastic parts of the Equipment at his own cost including the cost of transport.

5. After expiry of the warranty period of 2 years for UPS and thereafter AMC at tender finalised rates for 5 years, the Bidder/Contractor/Vendor/OEM will have to continue the AMC at mutually agreed upon (negotiated) rates within reasonable limits.

6. During the term of the Contract, OEM will maintain the equipment in perfect working order and condition and for this purpose will provide the following repairs and maintenance services:

   (a) Free maintenance services during the period of warranty and AMC. Professionally qualified personnel who have expertise in the field of Modular UPS & Lithium ion Batteries and will provide these services.

   (b) OEM shall rectify any defects, faults and failures in the equipment and shall repair/replace worn out or defective parts of the equipment during working hours i.e. from 8.00 A.M. to 8.00 P.M. on all working days (viz. Monday to Saturday). In case any defects, faults and failures in the Equipment could not be repaired or rectified during the said period, the engineers of the OEM are required to accomplish their duties beyond the said schedules in case of any situation if it warrants. In cases where unserviceable parts of the Equipment need replacement, the OEM shall replace such parts, at no extra cost to the Bank, with brand new parts or those equivalent to new parts in performance. For this purpose the Vendor shall keep sufficient stock of spares at its premises.

   (c) The maximum response time for a maintenance complaint from the site of installation (i.e. time required for Vendor's maintenance engineers to report to the installations after a request call / fax /e-mail is made or letter is written) shall not exceed 1 (one) hour.

(d) Vendor shall ensure that faults and failures intimated by the Bank as above are set right within hours of being informed of the same. In any case the Equipment should be made workable and available not later than the next working day of the Bank.

(e) Vendor shall ensure that the full configuration of the Equipment is available to the Bank in proper working condition with an uptime of 99.9% each month.

(f) Penalties for Warranty/AMC uptime (Quarterly) shall be as under;

S. No.	Uptime Range	Penalty
1.	99.7 to 100%	NIL
2.	98 to less than 99.7%	10% of Quarterly AMC Charges
3.	95 to less than 98%	25% of Quarterly AMC Charges
4.	Less than 95%	50% of Quarterly AMC charges

(g) OEM shall ensure that the Mean Time between Failures (MTBF) (including any malfunctioning, breakdown or fault) in the Equipment or any part thereof, during Contract period, not more than four occasions in preceding 90 days, it shall be replaced by equivalent/ superior new Equipment or part thereof by Vendor immediately at free of cost during warranty and AMC period.

(h) **Preventive maintenance**: Vendor shall conduct preventive maintenance (including but not limited to inspection, testing, satisfactory execution of all diagnostics, cleaning and removal of dust and dirt from the interior and exterior of the Equipment, and necessary repair of the Equipment) once every quarter (3 months) during the currency of the Contract on a day and time to be mutually agreed upon.

(i) All engineering changes generally adopted hereafter by Vendor for Equipment similar to that covered by the Contract, shall be made to the Equipment at no cost to the Bank.

(j) Qualified maintenance engineers totally familiar with the Equipment shall perform all repairs and maintenance service described herein.

(k) The Bank shall maintain a register at its site in which, the Bank's operator/ supervisor shall record each event of failure and /of malfunction of the Equipment. OEM's engineer shall enter the details of the action taken in such register. Additionally every time a preventive or corrective maintenance is carried out, the OEM's engineer shall make, effect in duplicate, a field call report which shall be signed by him and thereafter countersigned by the Bank's official. The original of the field call report shall be handed over to the Bank's official.

(l) The OEM shall provide replacement equipment if any equipment is out of the premises for repairs.

7. Any worn or defective parts withdrawn from the Equipment and replaced by OEM shall become the property of OEM and the parts replacing the withdrawn parts shall become the property of Bank.

8. Subject to the security requirement, Vendor's maintenance personnel shall, be given access to the Equipment when necessary, for purpose of performing the repair and maintenance services indicated in this GeM Bid.

9. If Bank desires to shift the Equipment to a new site and install it thereof, the OEM shall be informed of the same. The Bank shall bear the reasonable mutually agreed charges for such shifting and OEM shall provide necessary arrangement tothe Bank in doing so. The terms of this GeM Bid, after such shifting to the alternate site and reinstallation thereof would continue to apply and binding on OEM.

10. The Bank shall arrange to maintain appropriate environmental conditions, such as those relating to space, temperature, power supply, dust within the acceptable limits required for Equipment similar to that covered by this GeM Bid.

11. If, the OEM does not fulfil the provisions of clauses 4 (b), (c), (d), (e) and (h) only the proportionate maintenance charges for that period during the month will be considered payable by the Bank without prejudice to the right of the Bank to terminate the contract. In such event OEM was credited without deducting the proportionate maintenance charges for that month, the Bank can deduct the same from future payments payable or OEM shall refund the amount forthwith to Bank on demand by the Bank.

12. Future additions

    (a) The Bank would have the right to:

        i. Shift supplied systems to an alternative site of its choice.

        ii. Expand the capacity / enhance the features / upgrade the hardware / software supplied, either from OEM, or third party.

    Provided such changes or attachments do not prevent proper maintenance, from being performed or unreasonably increase Vendor cost of performing repair and maintenance service.